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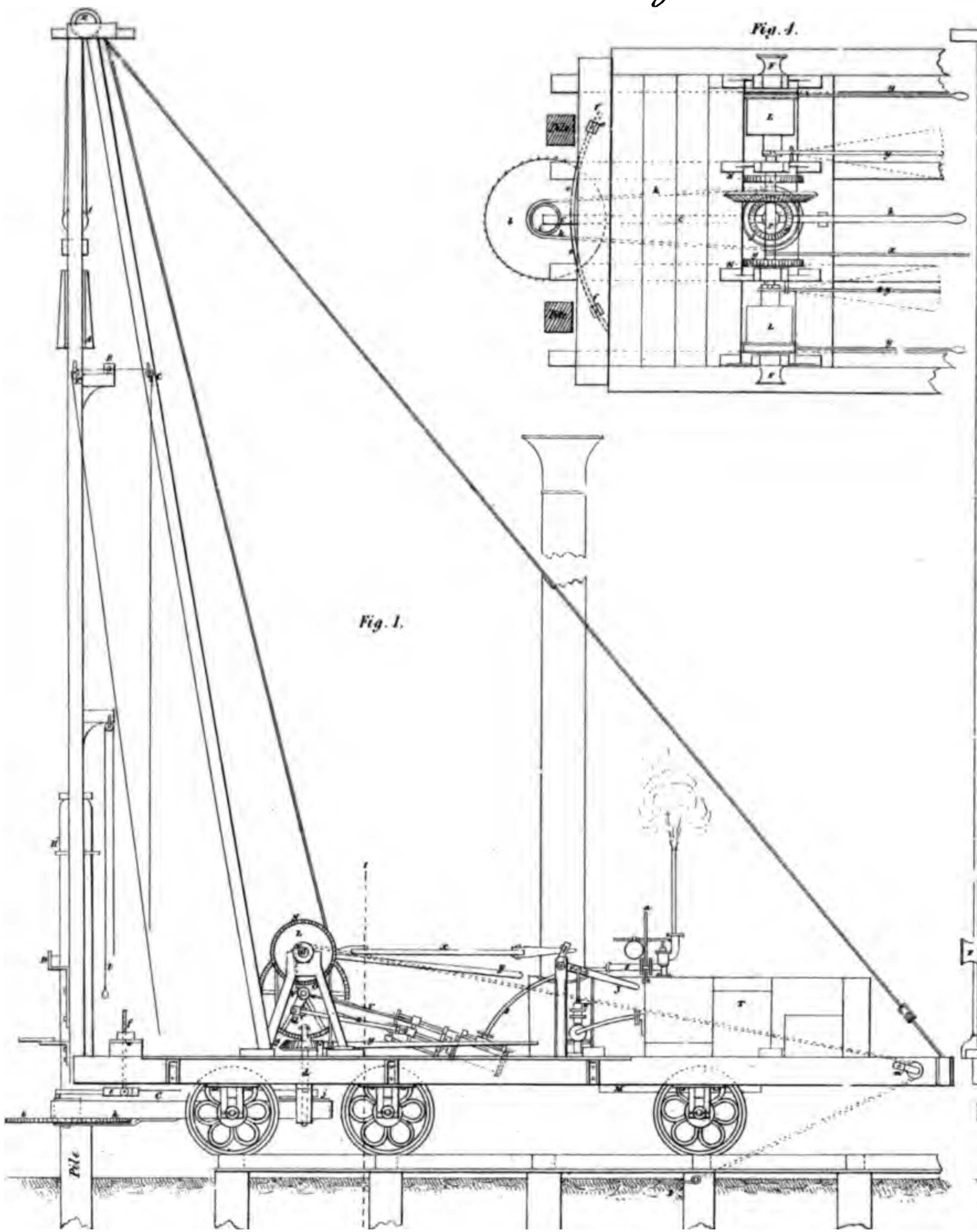
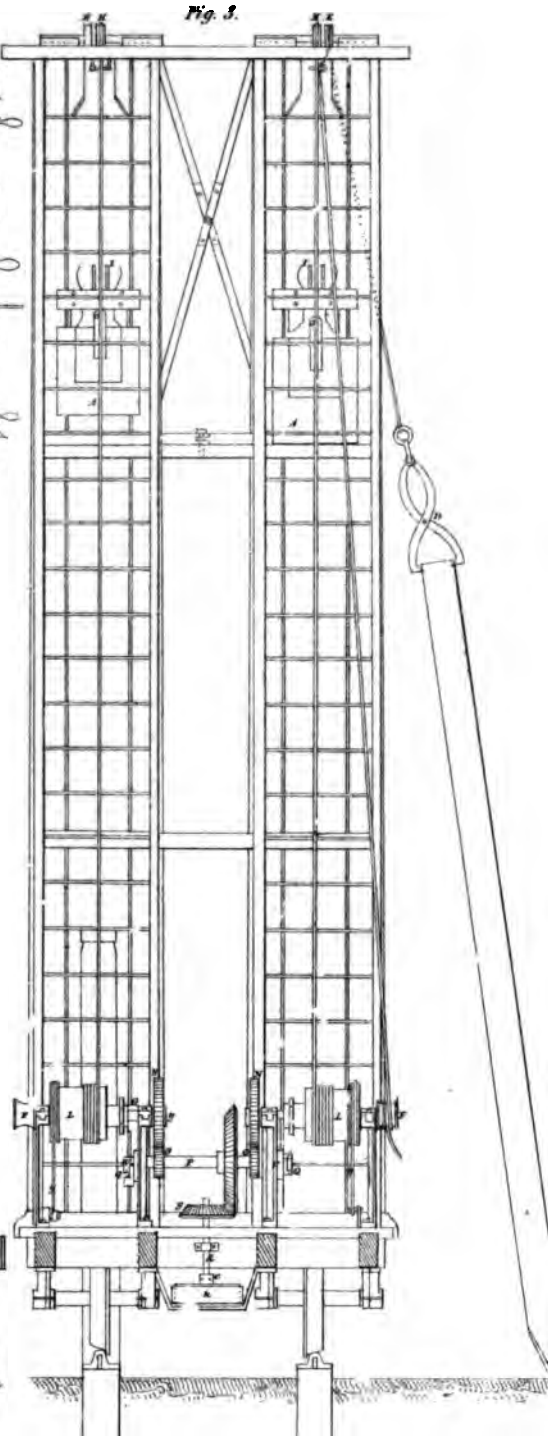


Fig. 4.

Fig. 1.



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THE

CIVIL ENGINEER AND ARCHITECT'S

JOURNAL,

THE AMERICAN STEAM PILE DRIVING MACHINE.

(With an Engraving, Plate I.)

In our last number we gave a brief account of this machine, which has been exhibited for the last two months at Smith's Wharf, Pedlar's Acre, Lambeth. Our information was principally obtained from the engineer, but since then we have had an opportunity of more carefully examining the machine, and obtaining some accurate particulars, together with a correct drawing of the machine, taken expressly for the Journal. The machine was imported into this country from the United States, by Colonel Cowdin, and some other parties, and consists simply of a locomotive engine, similar in principle to those used on our railways, having two inclined cylinders with their connecting rods, working upon cranks attached to the axes of two crab engines, instead of the wheels of the locomotive engine. The two crab engines perform the operation of driving the pile with a ram of the same weight, and in the same manner as those generally adopted for all the large works in this country, such as the coffer dam to the new Houses of Parliament and the bridges. With this machine two piles are driven at the same time.

In America the steam machine has been generally adopted for the construction of railways on piles, for which purpose it is well adapted, for as soon as the machine has driven a pair of piles, it cuts off the heads to a level, or with a slight inclination according to the *grade* required for the railway, and then rails are laid upon the top either with cross sleepers or not as may be desired; the engine advances forward another length and performs the operation again; thus one engine is enabled to drive two rows of piles at about five feet apart, one mile in a month.

The principal object of inquiry is to see how far this machine is superior to those in ordinary use, and as we just stated, in the steam machine we have simply engine power applied instead of manual labour, for the working of two pile driving machines of the same magnitude and power as those in ordinary use. For this purpose it is obsolutely necessary to make a series of observations and ascertain the number of piles that can be driven in one day by the steam machine, and the cost of labour, fuel and expenditure of capital, in comparison with the labour consumed in driving the same number of piles by the ordinary machine. At present, our materials do not warrant us in offering any opinion, but we shall hereafter attempt to obtain some information regarding this very important part of the inquiry.

For the steam machine, it requires to work the engine and apparatus for driving two piles at one time, with a ram weighing 16 cwt. the following men;—an engine-tender, one man for throwing each apparatus in and out of gear, and one man to attend to each pile, making altogether five men for driving *two* piles. For the ordinary machine it requires four men to work the crab engine for lifting a ram of the same weight, and one man to attend to the driving of the pile, making five men for *each* pile, or 10 men for two piles. With the steam machine the ram is lifted four or five times in a minute, thereby the operation of driving the piles is very short in comparison with the ordinary machine. The cost of the steam machine with an engine of ten horse power, tubular boiler and apparatus is about 700*l*., and the cost of the ordinary pile driving machine with crab engine is about 70*l*.

The following is a description of the American steam pile driving machine, and the operations for which it is applicable.

The machine consists of two pairs of leaders, similar to the common hand machine, placed 6ft. from centre to centre, (the common American railway gauge), and firmly bolted to a strong horizontal framing, and supported by two oblique ladders. The frame is 9 feet wide to the outside of the framing, and 28 feet long, it carries at one end a locomotive boiler 11 feet long and 2 ft. 6 in. diameter, calculated to bear 120 lb. per square inch pressure, but generally worked at 80 lb.

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per square inch, and about 100 strokes per minute. Under the boiler is placed the supply cistern. In the centre of the framing, and on each side of the boiler is a pair of inclined cylinders 5½ inch bore, with solid pistons working well without packing, and 14 inch stroke, which act on right angled cranks; and the gearing, drums, &c., described in the motions of the machine; the shaft centres are 1′ 3″ apart, the spur wheel has 56, and pinion 19 teeth; bevels 101 and 40 teeth; saw pulleys 1′ 9″ and 10½ inches diameter. The ram is generally raised from 4 to 5 times a minute, the steam being at 80 lb. per square inch.

For river work the machine is made much more compact, the apparatus is placed on each side and over the boiler, so that the stage is little more than half the length of the machine shown in the engraving, and it is also sometimes made with an apparatus for driving one pile only, consequently requiring smaller power.

In the drawing, fig. 1 is a side elevation of the machine; fig. 2, elevation in front of leaders, showing saw, &c.; fig. 3, a section taken in front of gearing, &c.; fig. 4, a plan of gearing end with leaders and ladders removed, and showing saw in plan, similar letters refer to similar parts in each figure.

Taking up the pile.—The ram A being secured by placing the stop B under it, by means of the small ropes attached to the latter, and passing over the small pulleys C C, to within 3 feet of the stage. The dogs D are made fast to the pile (fig. 3,) the rope attached to which passes upwards through the small guide pulleys, and over the outer pulley E, passes downwards and is coiled round the pulley F, fixed on the shaft G, which being made to revolve, raises the pile to its place between the leaders, and is then secured by the loose stay H, and the iron work H′ placed round it for guiding it perpendicularly.

Driving the pile.—The stop B being withdrawn from under the ram A, the ram is raised by a rope, which being secured to a staple on the top journal passes down under the pulley I, then upwards over the pulley K, and again downwards to the drum L, upon which the rope is coiled, the drum is placed on the shaft G, which is made to revolve by the spur wheel N, working in the pinion O, on the lower shaft P, which shaft revolves by the action of two cranks Q (Figs. 1 and 3,) placed on each end of the shaft P, the cranks are set at right angles to each other, and are worked by the connecting rods R, attached to the piston rods, which are furnished with slide parallels as shown in fig. 1. The slide valves of the piston are worked by the eccentric V, on the end of the shaft P. Steam is supplied to the cylinder by the pipe S, from the boiler T; the boiler is supplied with water from the cistern M, (fig. 1) by the pump W, which is worked by the eccentric rod X, fixed on the spur nave at Y, or by the handle at Z; the supply of steam is regulated by the handle (*a*) acting on a valve in the steam pipe (S). The drum L consists of a fixed and a loose cylinder, the latter revolving by the friction of the former (fixed), and is brought into or out of contact by the hand lever (Y) figs. 1 and 4, which has a fulcrum attached to the standard.

The follower *f*′ is furnished with a pair of tongs or clippers, which takes hold of a staple fixed in the ram, and carries it to the top of the frame; then when the top of the tongs is pressed closer together, by coming between the contracted checks *e*′ *e*′, the lower part opens and allows the ram to fall.

For working the apparatus the engine-tender stands at the valve S, and a man at the lever *y* of each machine. For raising the ram the man turns on the steam at the valve S, which sets in motion the apparatus of each machine, and coils the rope round the drums, at the same time raises the ram, as soon as the latter reaches the top of the leaders, the ram is detached and descends, at the same moment the engine-tender turns off the steam, and the men at the levers *y* throw the drum out of gear, which allows the clippers and chain to descend again and lay hold of the ram; when the drum is again thrown into gear, the steam turned on and the ram again raised, and so the operation is continued until the pile is driven.

Drawing a pile.—Chain tackle is secured to the pile and passed over the top pulley to the drum L, and is then drawn by applying the power to turn the drum of the apparatus.

The Saw Apparatus consists of a circular saw *b*, 4 feet diameter, having teeth set 3 inches apart, secured to the end of a beam *c*, which beam works on the upright shaft *d* for a centre, and slides laterally on on the iron arc *e*; when used the saw is adjusted to the proper height by the screws *f*, and a bar having a hook in one end and fitting into a staple in the beam's end, is used to press the saw against the work, the bevel pinion *g* being raised into gear by the foot lever *h*, (fig. 4), motion is given to the pulley *i* and *j*, and band *k*, which work the saw *b*. The operation of sawing off the end of a pile takes less than a minute.

Progressing motion.—The hook *l* being fastened to a driven pile, and the rope passed over the pulley *m* attached to the side of the frame to the pulley F, round which it is coiled twice, and the end held by a man—motion being now given to the drum, the machine progresses—this motion is shown by the dotted rope fig. 1, it should be stated that the frame is intended to be supported upon six railway wheels, which run on a temporary rail laid on the top of the piles as they are driven. There is another mode of progressing, but which is not found to answer so well, viz. by means of two sledge beams faced with iron and attached to the under framing, these are placed six feet apart from centre to centre, and pass under the whole length of the machine, and slide on small iron wheels fixed to standards, which are placed loose on the piles.

The plumb-bob *l* suspended to a line regulates the pile being driven perpendicularly, and Y is a lever attached to a friction band break passing over the end of the drum, which is only used occasionally.

It is remarkable that writers on mechanics have not been able to agree on the precise manner in which the force of the blow given by the ram of a pile engine should be estimated, and the question appears to have been greatly confused by confounding it with the effect produced in sinking the pile. Now it is one thing to estimate the force of a blow, which is simply to determine the weight which, acting by pressure alone, will produce the same effect as the blow, and it is another thing of a widely different nature to determine what that effect actually is. Any practical man at all acquainted with the nature of pile driving, will at once scout the idea of being able to establish the law, according to which a pile will actually sink by successive blows of the ram; because it is well known that the sinking of the pile is by no means regular or proportioned to the friction opposing its descent as determined by theory. On the contrary, in defiance of all theory, a pile will sometimes sink more at the 4th or 5th blow, than at the 1st or 2nd, or perhaps more at the last blow than it did 10 or 15 blows before; and yet it is obvious that if we were attempting to investigate theoretically the resistance of friction, we must estimate this resistance to increase in some regular proportion to the depth to which the pile is buried in the ground.

Practice, however, shows that occasionally the resistance is *less* than at a previous blow, when theory would point out that it is *more*. We therefore reject from our consideration every attempt to determine the actual effect produced by the force which we are able to exert on the pile. In fact, whether the blow produce any effect or not, the force exerted is still the same, and this is all that theory can determine, because the sinking of the pile depends on conditions of tenacity and consolidation of the ground to be driven into, which are too various and complicated ever to be capable of general expression in the formulæ of calculation.

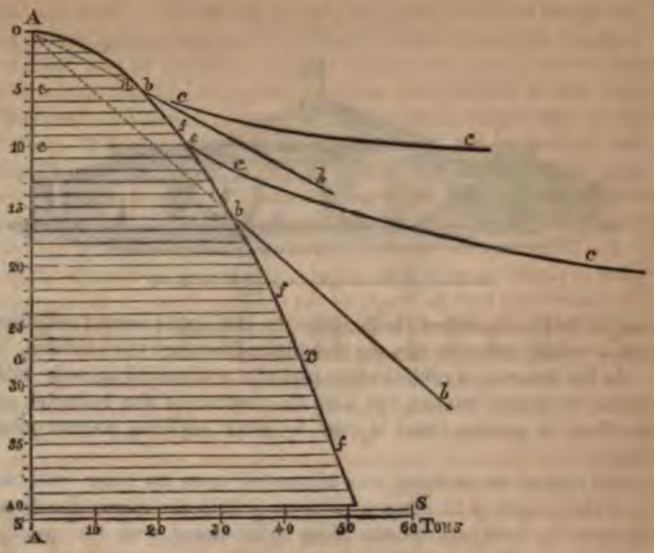
It is true that Belidor and other French engineers, in that ardent spirit of investigation which leads them to build up theories on a purely hypothetical basis, where a practical or experimental one is impossible, have assumed the rate of consolidation of earth at each successive foot below the surface, and then taking into account the surface of the pile exposed to friction, have attempted to estimate the rate at which the pile would sink with each blow of the ram. We doubt, however, whether practice would ever be found, in a single instance, to confirm a theory so established; at any rate we should esteem the coincidence of the two almost miraculous, even if, in some rare instance, they ever have agreed.—Apart, then, from all consideration of the effect produced in sinking the pile, let us simply enquire the actual force with which the ram, in falling from a given height, strikes the head of the pile. Obeying the law of accelerated velocity, the ram will fall through any space s in the time $\sqrt{\frac{s}{g}}$, where $g = 16\frac{1}{12}$ feet, the space through which a heavy body falls in one second of time. Now it is a fixed and well established rule in mechanics, that the velocity acquired by falling through any given height is proportionate directly to the time of descent, and that the velocity acquired at the end of the first second of time is equal to $32\frac{1}{6}$ feet per second; hence it follows that the velocity acquired by a body in falling through the space s is equal to $32\frac{1}{6}\sqrt{\frac{s}{g}}$. Then to find the force of the blow, the weight of the body is to be multiplied into this acquired velocity, which it must be understood is not the velocity with which the body has fallen, but the velocity in feet per second with which it would fall during the next instant of time, were it not suddenly stopped by striking the pile.

According to this formula, the following table has been calculated, showing in one column the time of descent in seconds of any ram falling from 1 to 40 feet, and in the other, the force in tons with which a ram weighing one ton will strike, in falling from the same height.

Fall of Ram in feet.	Time of Descent in seconds.	Force in tons for a Ram weighing one ton.	Fall of Ram in feet.	Time of Descent in seconds.	Force in tons for a Ram weighing one ton.
1	0·25	8·0	21	1·14	36·7
2	0·35	11·3	22	1·17	37·6
3	0·43	13·9	23	1·20	38·5
4	0·50	16·0	24	1·22	39·3
5	0·56	17·6	25	1·25	40·1
6	0·61	19·6	26	1·27	40·9
7	0·66	21·2	27	1·29	41·7
8	0·70	22·7	28	1·32	42·4
9	0·75	24·1	29	1·34	43·2
10	0·79	25·3	30	1·37	43·9
11	0·83	26·6	31	1·39	44·6
12	0·86	27·8	32	1·41	45·4
13	0·90	28·9	33	1·43	46·1
14	0·93	30·0	34	1·45	46·8
15	0·96	31·0	35	1·48	47·4
16	1·00	32·1	36	1·50	48·1
17	1·03	33·1	37	1·52	48·8
18	1·06	34·0	38	1·54	49·4
19	1·09	35·0	39	1·56	50·1
20	1·11	35·9	40	1·58	50·7

The force of the blow given by a ram of any other weight than a ton may be ascertained from this table, by simply multiplying the number in the column headed "Force, &c." by the weight of the ram. Thus, if it be required to determine the force of the blow given by a ram of 16 cwt. falling from a height of 30 feet, opposite 30 we find the tabular number 43·9, hence 16 × 43·9 = 702 cwt. = 35 tons 2 cwt. the force required. This is the greatest force of the blow which can be given by the steam pile-driving machine described in our present number, the error formerly made of stating the force of the blow at 600 tons was on the authority of one of the foremen superintending the engine, and we take the earliest opportunity of correcting a statement so exaggerated.

The annexed diagram is intended to represent, by means of the curved line *f f f*, the law according to which the force of the blow increases with the height from which it falls. For example, the distance *a x* measured on the horizontal scale will be 42·4 tons, the force with which a ram weighing one ton strikes when it has fallen from a height of 28 feet. The peculiar curve here shown is the result of that law by which the forces vary as the square roots of the heights from which the ram falls. If the forces varied directly as the heights, the straight lines *b b* would express the law of their increase, and if they varied as the square of the heights, a supposition which, erroneous as it is, has been entertained by some persons, the law of the forces would be expressed by a curve of an entirely different nature from the true one, namely by the curves *c c*, according to which, if *e d* were the force for a height of 5 feet, *e e* would be the force for a height of 10 feet. The straight lines and the curves *c c* are of course both erroneous, the true scale for measuring the forces being afforded by the curved line *f f f*, so that the distance *a x* of any point *x* from the vertical line A A, measured on the horizontal scale S S, will give the force of the blow correctly in the same manner as the table.



THE LIVERPOOL PAVILION.

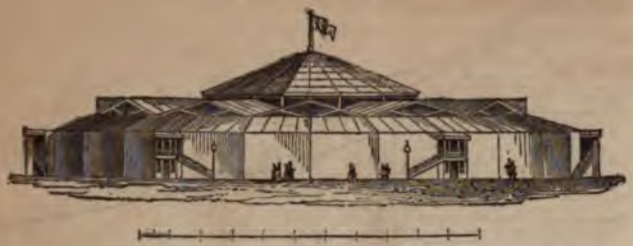
Erected at Liverpool, July, 1841, *for the Great Dinner of the Royal Agricultural Society of England, under the direction of* J. W. Wild, *Esq., Architect.*

The object of this dinner is to afford an opportunity to the members of the society, assembled from all parts of the kingdom, of hearing persons eminently connected with agriculture and scientific men, speak upon points of special importance to them. The pavilion requires, therefore, no decoration, as it would for a festive occasion; all that is wanted is that it should be convenient for seeing and hearing the speakers, and for serving the dinner, and that it should cost the Society as little as possible.

The plan of the Pavilion at Liverpool, as shown in the annexed engravings, is a polygon of 24 equal sides, the greatest diameter between the opposite angles being 171 feet; within this space was provided accommodation for 2850 people, allowing 1ft. 8in. by 3ft. 9in. to each person, besides the main passages, which were four feet wide, and the committee-room and butteries. The staircases, 3ft. 6in. wide, were outside the building. A portion within this figure being cut off to form the offices, the remaining space for the seats was nearly the form of an ancient circus; the arrangement also was similar, as there were no galleries, the seats rising in steps around, and following the line of the outer wall. In order to bring the President's and Vice-President's tables nearer to each other, the high table was advanced from the wall some distance towards the centre of the building, thus leaving some few seats behind the high table.

There were six entrances into the body of the Pavilion, two upon the ground, leading into the pit, two above these into the upper seats,

Fig. 1.—Elevation.

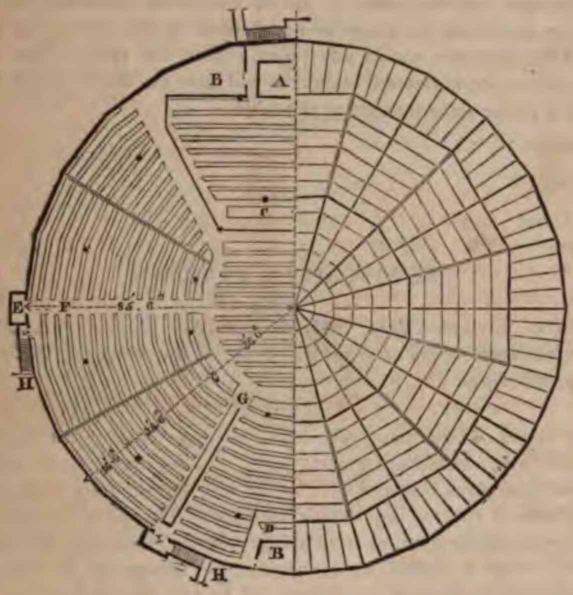


and two other staircases leading also to the upper seats, and there was a private entrance into the committee-room and the platform.

As the dinner was cold, the first part of it was served upon the table before the guests entered, and from the position of the butteries and pantries, the waiters found it easy to serve anything wanted afterwards.

The roof of the building was supported upon its outer wall, and upon two ranges of 12 columns each, one within the other; the disposition of the roofs and columns being symmetrical with the arrangement of the seats, the sight was but very little hindered by these few supports, which were posts, 12 inc. square, with the edges chamfered.

Fig. 2.



Plan of Seats. Plan of Roofs.

Reference to Plan.

A. Committee Room. B, B, Buttery. C, High Table for President, &c. D, Vice President's Table. E, Pantry. F, Passage to Upper Seats. G, Passage on the Ground to Lower Seats. H, H, Staircases.

The entire covering was divided into three roofs, one within the other. The centre roof, 72 feet in diameter, was a pyramid of 12 equal sides, the apex was 40 feet from the floor; the base or top of the posts supporting the wall plate was 29 feet from the floor. The construction was 12 rafters, forming the angles of the pyramid, each (13in.×4in.) abutting against each other in the centre, and secured there by a star-shaped strap of half inch wrought iron, each leg of which, 1ft. 2in. from the centre, was bolted to each rafter; the other ends of these rafters were secured and prevented from spreading, by connecting the wall plates with strong wrought iron straps, each two feet long, and forming thus a hoop round the base of this roof. The ends of these rafters were also bolted to the upright posts. Light was admitted through a space round this roof under the wall plate; the purlines supporting the oil cloth covering were laid upon these principal rafters.

The middle division of the covering between the outer and inner range of supports was divided into 12 gable roofs, as their ridges were level, and all tended to the centre; the valleys formed by the sides of these roofs meeting each other, rise towards the centre, and thus easily carry off the water. No ties were required, as the rafters of each division abut against each other on the valley pieces, which, supporting a considerable weight, required trussing; the trusses used for these valley pieces (13in.×4in.) was an iron rod ¾in. thick, bolted to each end of the piece, and an oak wedge being forced between this rod and the underside of the beam formed the truss.

The gable ends of these 12 roofs also admitted light, and being under trusses, their tiebeams formed a continued line of support to one end of the rafters of the beam to the roof; the other ends of these rafters (averaging 17 feet long) are supported on the outer wall, this lean-to roof round the building, being the third or outer division of the whole covering.

It is to be remarked that within the space included by the covering, there is not one horizontal or isolated tie.

The material used for the covering was floor-cloth, prepared only on one side; it was returned to the maker after the building was taken down; the floor of the Pavilion was supported on 9in. brick walls, the outer enclosure was faced with the outside slabs, sawn from timber; the average height of which was 15 feet from the floor. Light was obtained through the gable ends of the roofs, and the upright portion of the centre roof, all of which were enclosed with white calico.

Mr. Wild's plan, with a model explaining it, was submitted or tender, together with the drawings, &c., of another plan previously executed for the society; this other plan was a parallelogram 113ft. × 197ft. offices attached 14ft. × 84 ft. The covering was a series of lean-to roofs; the accommodation offered by both plans was equal. The tender for this plan was £1225; for the plan adopted at Liverpool £1115; this difference of expense may be accounted for by the quantity of external enclosure being much less in the Liverpool plan, owing to the greater capacity of the figure; and as each of the 12 divisions of the plan is exactly repeated, without any curved lines and very little cutting, the construction is very simple. The principal waste was in the covering of the centre roof. As no ornament was attempted, the effect of the building was rude and naked, but the great multitude of people in still widening circles around, had a grand effect. As the plan was symmetrical, architectural decoration could have easily been given had it been required.

The position of the building was very disadvantageous for hearing, it being in a very noisy part of Liverpool: indeed, if, on the day of the dinner, a space around had not been covered with refuse bark, nothing could have been heard.

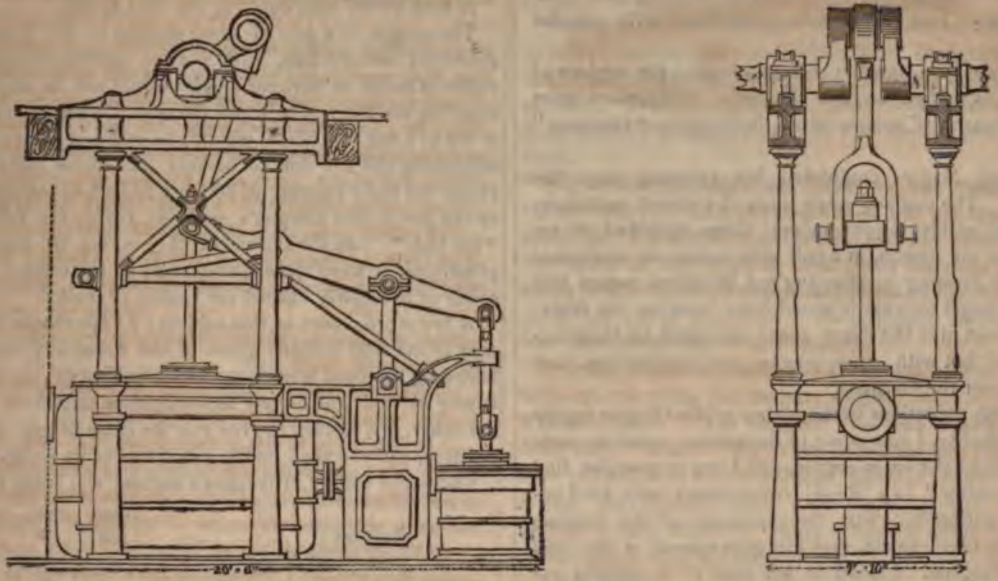
There was no echo perceptible in the building, the voice seemed to spread and lose itself as in an open yard. It was generally agreed that those who spoke clearly and articulately were well heard. For instance: Lord Stanley made a long speech, and seemingly without any great effort or loudness, and every word was distinctly heard in all parts.

The building, with its covering, remained standing altogether about six weeks; it was exposed to some very severe weather, but showed no sign of weakness any where. It was erected by the well known and respected builders, the Messrs. Holmes of Liverpool, whose execution of the work gave general satisfaction.

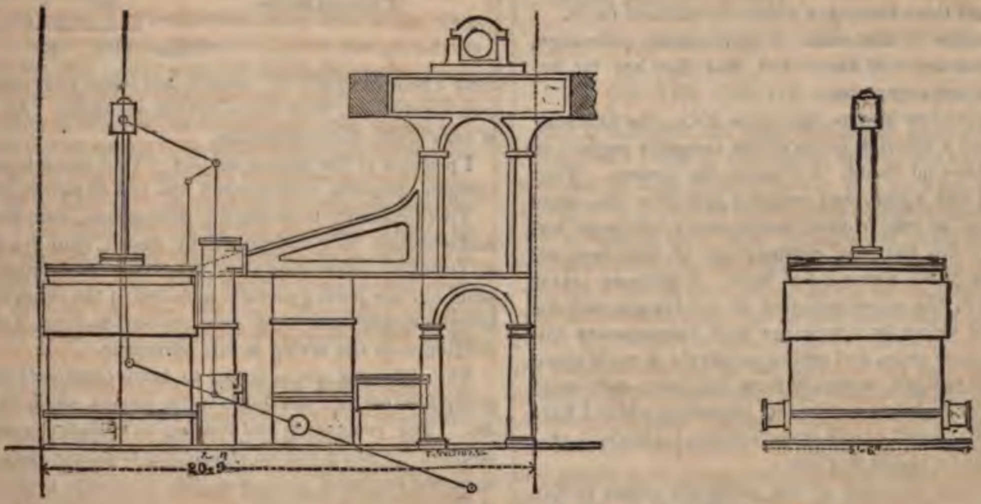
The Gorgon Engines.—We have seen a set of drawings of these engines, prepared by Mr. Jermyn, for presentation to the Model Gallery, Somerset House, which do credit to the public spirit of the engineers and the skill of the artist. They show fully how the most practical subjects when properly treated become objects of beauty. We should like much for every engineer to present such records to public institutions, where they may be studied by the profession.

ON BEAM AND DIRECT ACTION ENGINES.

GORGON ENGINE.



BEAM ENGINE.



SIR—I am induced to address you from having read, in a contemporary work, a review of Mr. Scott Russell's publication on Scotch steam navigation, wherein concise mention is made of the engines termed "Gorgon," so *scientifically* named from their having been first fitted on board a vessel of that name.

Giving unto the manufacturers of these machines great credit for their general talents and ingenuity, and having a high opinion of their ability, I nevertheless, with reference to this particular case, have great doubts of the correctness of their title either to *originality in introduction*, or to any credit in *conception* or invention. I trust also that these gentlemen will not consider me to be actuated by any unfriendly motives; some of the published statements and assumed facts seem to me to be a little overcharged, and my desire is to induce explanation, and, by controversy, establish in your pages a conclusive and convincing account of all the properties of the arrangement, and at the same time, by comparative data and drawings, show its preference or defect over other plans, more especially to the common beam, or Boulton & Watt marine engine first fitted on board the "Favorite" Margate steamer, in 1818.

It must be in the knowledge of most of your professional readers, that engines having a "*direct action*" were common many years ago, and it was not until the novel arrangement of the "Favorite's" engines became generally known, that they were put aside; since then the beam engine has reigned triumphant, to the *partial* usurpation of the Gorgon; it is my object to show the said "Gorgons" are not entitled to the position they may be said to have attained in the *royal navy*.

In the year 1822 a vessel was built at Leith, and was named the "Tourist;" her engines were of the "direct" kind, designed and manufactured by Mr. GUTZMER, also of Leith, and were, I may safely say, the *first ever made* for marine purposes. The arrangement was very like Mr. Penn's oscillating engine; the cylinders were of course fixed, having *one* air-pump worked by a crank in the middle shaft; the condenser was a circular one, fixed before the air-pump in the middle line of ship. The cylinder was 40 inches diam. and 3 feet stroke, equal to a power of 40 horses, the space occupied was 10 ft. 9 in. in the fore and aft direction, and 11ft. 6in. athwart; the vessel was low, and the paddle wheels being *proportioned to the stroke*, the connecting rods were *short*. The piston rods were fitted with parallel motions.

Thus, so far as the *direct application of the power goes*, the engines of the Tourist, Gorgon, Cyclops, &c., are *identical*. I therefore must object to the Messrs. Seawards' nomenclature, it should be "Gutzmer" not "Gorgon."

In 1826, Mr. David Napier completed his splendid ship, the "United Kingdom." The engines were upon the direct principle, with, I conceive, considerable improvements; these consisted of separate condensers and air pumps, in a half side beam, an additional crossbar, and *side rods forming a connecting rod*, by which means this latter was *doubled in length* to what it would have been on the Gutzmer principle. I cannot give the exact space occupied by these engines, but feel assured that with equal powers and capabilities, they have the advantage over the Gorgons.

Having explained my objections to the claims of the Gorgon engine on the ground of originality, I now come to its *intrinsic* value as compared with its competitor the beam engine, and I beg to premise that I use the term "competitor" in a *Royal Navy* sense only, for I believe I am correct in stating that, with the exception of the Russian Emperor and Mexican Government, that this government is the only patron of the Gorgon engine. I mean to say that it is entirely excluded from the *vast* commercial marine of this country. I think I may also say entirely from France, but I am open to correction on this point; at all events, the former fact shows plainly, that *if* it has no defects, it at least has not the advantages which are claimed for it. I may observe, with reference to the value of government patronage, and I merely state a plain and well known fact, that they are far behind private knowledge and enterprise.

In a pamphlet published by Messrs. Seawards & Co., the following statements are made, and a drawing given of the Gorgon's engine; of the latter's accuracy I have no doubt. I dispute the former. They say, 1st, they occupy ⅓ less space, and weigh ¼ less than the beam engine. 2nd, that there is less friction, consequently less wear and tear and loss of power. 3rd, that the consumption of fuel does not exceed 6½ lbs. per horse power nominal per hour. I purpose taking these as they stand. 1st, the space occupied by the Gorgon and the beam engine can only be shown by a drawing; such accompanies this letter, sketched to the same scale, and placed relatively to each other. The upper is that of the Gorgon, as copied from the above-mentioned pamphlet, the lower is of a beam engine, in sketching which I have not followed the "architecture" of any manufacturer, for obvious reasons, having no professional object in view.

You will therein see that the base of the Gorgon's engine is 20ft. 6in. long by 7ft. 10in. wide, that of the beam engine 20ft. 9in. long by 8ft. 6in. wide over the main gudgeons or widest part, being in excess, *three inches* in length and *eight inches* in width only! This is an astounding fact, and before publishing this paper (if it is doomed to such fortune), I beg, Mr. Editor, that you will carefully look to this point, and test its accuracy; I believe it is fair and honest, and, if published, will speak for itself. So much for the boasted Gorgon engine, ⅓ less,—'tis a hacknied phrase. It does not appear that any claim is made for improvement in the boiler. I have a drawing of the Cyclops'; they are of the common construction, single flue (that is, all on one level) having fires at both ends; they are across 19ft. by 31ft. fore and aft, and 8ft. 10in. high; this is all common-place. I have therefore no remark to make until I speak of their weight, and the reported consumption of fuel.

I now come to the *weight* of the Gorgon's machinery, and premise that this is a point of great importance, as I have reason to think its reported *small amount* was ONE of the principal causes of the introduction of these engines into the navy of Great Britain.

The engines were stated to the government to weigh 121 tons.

Paddle-wheels	24
Boiler	64
Water in Boilers	48
	257 tons.

A total of 257 tons omitting the coal boxes.

The weight of a pair of beam engines of 320 horses power of most approved construction, with boilers, paddle-wheels, *coal boxes*, and water in boiler to working height, would not be more than 290 to 300 tons, but say the latter, to put the question on its broadest base, that is ·93 of a ton to a horse, which you will find a very ample allowance. Supposing the 257 tons to include coal boxes (although not enumerated) we have a saving of 300 less 257 = 43 tons and $\frac{300}{43} = \frac{1}{7}$ saving by the use of the Gorgon's engines! really, Mr. Editor, this appears "too bad." Can the statement of ¼ saving be made on honourable principles, or wero the manufacturers so far carried away by enthusiasm as to *slightly* exceed the bounds of truth?

A few words more on this subject; I have reason to doubt the accuracy of the total weight given to the Admiralty, viz. 257 tons. The following has been handed to me by authority on which I can rely. It may be said it is merely an anonymous statement. Granted; but I am ready, Mr, Editor, to give you the name of my informant (in confidence), and you shall be the umpire as to its value.

Corrected weight of Gorgon's engines will stand thus;—

	Tons.	cwt.	qrs.	lb.
Engines . .	123	3	0	13
Paddle-wheels .	40	0	3	24
Boiler . .	68	17	2	5
Chimney . .	6	3	3	6
Coal Boxes .	20	2	1	18
Water in Boiler .	40	8	0	0
*Total	298	15	3	10

I say I believe this to be correct, and leave your readers to form their own conclusions, or to make further enquiries. All I can say is, that it calls loudly for explanation.

I proceed to the second subject "That there is less friction in the Gorgon's engines, consequently less loss of power, wear and tear, &c.

This I consider to be merely professional, and fear my inability to make myself fully understood by casual readers; however, avoiding all scientific observation as to the "laws of friction," I shall merely point out the parts generally included in the beam but avoided in the Gorgon engine, and allow your readers to draw a common sense deduction as to the saving in this particular.

The following are common to both constructions: the pistons, air pump buckets, hot and bilge water pumps, shaft bearings, crank pins, &c. The connecting rod bearing on cylinder cross bar of Gorgon, is equal to the beam engine connecting rod cross bar; in this latter we have the two main gudgeons, the air-pump gudgeons, the side rod gudgeons, and the parallel motion, to be balanced by the rocking beam and parallel motion of the Gorgon engine; aud although last, not least, the enormous friction on these parts caused by the short connecting rod, and which I am assured is so great as to equal ⅓ the power of the engine passing through them to sustain the piston rod to move in a perpendicular line.

On this point I am content, that those who are cognizant of the parts of both engines, or can judge from the drawing given, may form their own conclusions.

3rd. That the consumption of fuel does not exceed 6½ lb. per *nominal* horse power per hour.

Nothing can be more absurd than to draw any conclusions from the consumption per nominal horse power, the merest tyro in the profession must be fully aware that in the same engine (or generally speaking in engines from the same manufactory), the consumption of coal *will always be as the work done;* it matters not how you may turn and twist this fact, it is still so; by loss on the slide valve you save steam, but you reduce your power* in the same proportion; and was moderate consumption of fuel the only desideratum it is easily obtained; you may save coal by not using *steam*, and that is simply done by preventing its ingress to the cylinder. Thus actual power is reduced, but nominal power is fixed, and hence the result of 6½ lb. consumed on board the Gorgon.

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* We must observe that this weight includes chimney and coal boxes, not included in the before-mentioned weight of 257 tons.—EDITOR.

I may here incidentally observe that a good marine engine should exert an average pressure on the piston of 14 lb. per square inch, and this exclusive of all friction of the moving parts; this, according to Mr. Watt's computation is just *double* the nominal power. If under these circumstances it consumes 9 lb. of coal per *nominal* horse power per hour, or 4½ *actual* horse power, you may be content. I have known this exceeded, but think it rare; a pressure of 16 to 16½ lb. on the inch is common in these days, and that with a boiler pressure of 6 lb. Therefore to form a fair experiment of the consumption we ought to be favoured with an indicator figure, showing the average pressure, with the speed of the piston per minute.

The Gorgon's cylinders are 66 inches diameter and 5 ft. 6 in. stroke, and according to Mr. Watt's computation, (I take his data as I consider it beyond cavil), should make 20 strokes per minute, or 220 feet, producing a power of 160 horses, or 320 for both engines. This is just equal to 18·57 cwt. per hour, is this fact? I put it Sir, to your own knowledge, as well as to that of your general readers.

One other point only remains to be considered, the actual speed of these Gorgon's engines. I am told in consequence of the great immersion of the Gorgon, her engines seldom make more than 14 to 15 strokes per minute, if this is true the mystery is solved, the consumption of coal is increased at once in the proportion of 20 to 14, equal 9¼ lb. per *nominal* horse, about the usual thing supposing the actual power *double* as above stated.

Of the "Styx" I can speak with confidence, on her trial in the river, with my Lords and a large party on board, with coal enough for the trip, no masts, stores (except, to the credit of the engineers be it said, no mean supply of the *very* good things of this world), guns, &c., at her *light draft* she made 17 strokes per minute, and when loaded it is reasonable to suppose the increased resistance would reduce that two or even three strokes per minute at least; therefore how utterly inconclusive it would be to form any judgment as to the consumption of coal upon such data. No, this may do for the government folks, but the steam public will require deeper investigation; let us have an indicator figure, the number of strokes per minute, the speed of vessel with her immersed section, and then we shall be enabled to see if modern ingenuity has done more than old "Gutzmer" did in the "Tourist."

There are other defects attached to the Gorgon engine which deserve notice. It has been frequently observed, even by unscientific persons, that in the "beam engines" every part was beautifully adopted to its purpose, and was so well *balanced*, that disconnected from the shaft it preserved its position, it results that its motion is equable and smooth, with a minimum friction on the moving parts. Although I differ from those who suppose there is a *mechanical* loss of power in the use of the short connecting rod, still I conceive the most sanguine supporter of the "direct engine" must allow there *is* a loss of power from attendant causes, the undue friction thrown upon the parallel motion upon the shaft bearings and other parts, in consequence of the oblique action of the connecting rod, and more than all the *irregular motion* arising from the weight of the pistons, connecting rods, cranks, cross bars, &c. being *totally unbalanced*, except by the paddle wheel, which I consider so rude as out of the pale of civilization, and which, by the bye, cannot be carried into effect when any apparatus is fixed for disengaging the shaft, as the paddle wheel would not revolve, the very end to be obtained by such device.

Another disadvantage is that in order to get a moderately long connecting rod, you are obliged to construct your paddle wheel much too large in diameter for the stroke of the engine, and in order to reduce your resistance, to contract the *length* of the board; this applies to all our Government vessels hitherto fitted with direct engines, and in fact to this I principally ascribe their low speeds.

Puffing is a horrid resource; I have been amused to see the manner in which the Gorgon and Cyclops were brought before the public on the recent bombardment of the Syrian coast; surely this is unfair and not national. The Phenix, Medea, Hecla, Hydra and many others did *their duty*, which I presume is all the first named were called upon to perform.

One observation more, and I fear I am only disseminating a generally known fact, that the great majority of our war steamers have *very low velocities*. I know not what other countries possess, but this must be evident to all, that (putting aside great disparity of force), the fastest steamer will be the conqueror, and thus as in the American war, our noble tars will be sacrificed to the miserable inefficiency of those who have the governance of such matters.

I conclude with a prophecy. Fashion must have its course in steam as in other matters, but ere long we shall come back to the scandalized "Beam engine." The Gorgons may shake their heads, and Cyclops wink their "central orbs," they will meet the fate of the "*Tourist*," now propelled by a pair of beam engines. Like in the paddle wheel mania, we gyrated from poor Buchanan who "shone" in 1814, through a vast series of minor inventors down to Morgan, who *went out* in 1838 or thereabouts;—this is all very well, and is good for trade, but who pays?

I remain, Sir, your's truly,

VULCAN.

London, December 9, 1841.

ON THE USE OF GOLD IN DECORATION.

SINCE architects are beginning to pay more attention than formerly to the minor parts of decoration, it may not be venturing out of their province to turn their attention to a very important branch of it—though it is ground on which, from being confined by the impregnable laws of fashion, it is more dangerous to tread than even the slippery path selected by Mr. Bartholomew. When we have designed our decoration with the greatest attention to harmonious colouring, taking care that each may have its proper proportions, and making a cautious use of bright colours out of regard to those which are more subdued—the artist comes, and to the injury of his own works, as well as those of the architect, covers the wall with a phalanx of rich gold frames of precisely the same character, whatever may be the tone of the room or the nature of the picture. If the statements of Mr. Clarke be correct, that yellow is to be used with great caution and never in large quantities, and it undoubtedly is correct, and is universally allowed to be so, except in this one point, it surely is contrary to every principle of colouring, either in decoration or the management of a picture, to introduce this dangerous material in a manner entirely regardless of surrounding or surrounded objects. Pictures of the most delicate as well as the boldest character have frames to match each other rather than themselves—and this because no one has the courage to propose a remedy. Artists are not much afraid to intimate with caution that the talon-like form in which the finger nails are suffered to luxuriate, has no authority in the antique. Some one more hardy than the rest, suggests to a lady that if her daughter's waist was really pinched as small as she wished it to be represented, "she would not be alive a minute." But the other practice is too finely paid, for any one to attempt its removal—though we must not despair of time effecting what no other less potent agent can. Equally absurd and deeply rooted fashions have given way. It has been discovered that the human form is seen to more advantage in a simple garb, than when the upper extremity appears emerging from a gigantic cheese. And possibly it may be found that works of art, more precious than diamonds, like them do not require to be set in gold. We have Sir William Gell's authority, than whom no one had a better opportunity of studying internal decoration as practised by the ancients—that the suggested innovation would be in accordance with the principles of those whom we profess to follow and admire.

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* The writer of this paper does not think it necessary to explain the theory of expansion, to show that the power lost by it is *not* in proportion to the steam saved, nor is it worth while to show that the speed of the ship would be reduced as the cube roots of the lost power, his desire is to prove the unsoundness of reasoning upon nominal horse power consumption.

If the space taken up by frames at the Royal Academy were occupied with some quiet separating colour, the pictures being surrounded with simply a gold moulding, we should not hear so many complaints of the killing effects of the exhibition to all pictures that are not painted after Turner's manner. Gold in large quantities will some day assuredly be banished from the picture gallery, to situations where it is required as an architectural decoration, and where it will therefore be subjected to the disposal of the architect instead of to that of the frame maker.

J——L.

AN APPARATUS FOR DISCONNECTING THE PADDLE WHEELS OF STEAM VESSELS FROM THE ENGINES.

By Mr. Grantham, North Foundry, Liverpool.

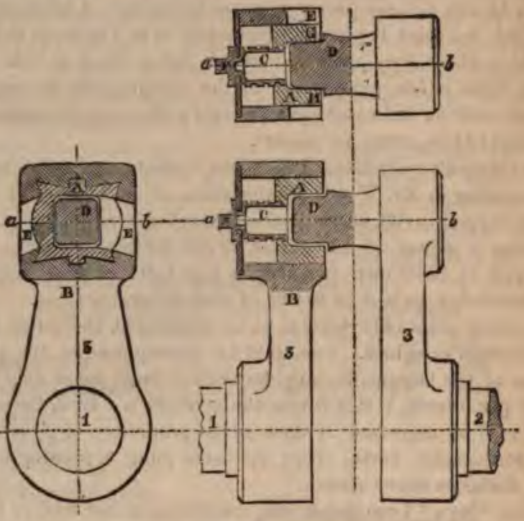
To effect the connection and disconnection of the paddle shafts of steam vessels, has been the subject of many ingenious plans, but we have not seen any which appear better calculated for this purpose than that of Mr. Grantham, a description of which we now give.

The parts of the annexed diagram marked 1, represent the paddle shaft of an ordinary marine engine, 2 the intermediate shaft, and 3, 3, 3, the cranks by means of which the engines are made to revolve. This new contrivance consists in having in the eye of the exterior crank, a sliding brass step A, which may be moved in either direction by the screw C. The screw to be worked by a ratchet spanner on the square end F, and to be of such pitch that one revolution for small vessels, and two for larger vessels, will be sufficient to effect the operation.

The sides of the brass step project unequally, as at G and H.

For Disconnecting.—The brass step is drawn back by the screw C to allow the crank pin to pass clear.

For Connecting.—The brass step is moved forward one or two inches, so that the crank pin can pass the side G, but comes in contact with H. The correct position of the several parts being thus determined, the brass is screwed out to its full extent.



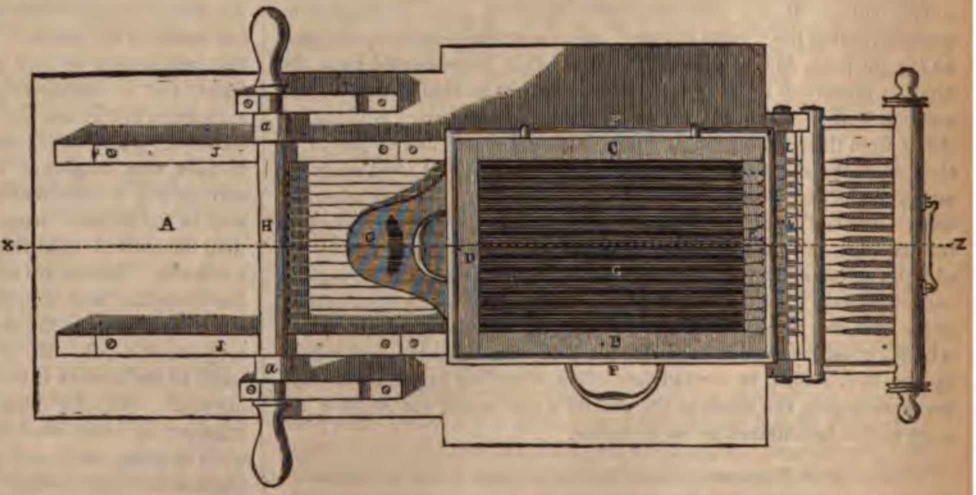
TILE MACHINE.

New Patent Invention for the Manufacture of Draining and other Tiles and Bricks. By William Irving.

The advantages of the machine exhibited in the annexed engraving are its simplicity and cheapness in its construction and working. It is stated by the Patentee that by the labour of one man and three boys, 5000 tiles per day can be made with ease, at a cost of less than 2s. per 1000. At one operation 16 tiles are made, which an experienced hand would accomplish in one minute, equal to 9,600 per day of 10 hours.

The machine is so portable that one man can carry it, and needs no fixing.

The machine may be seen at work at Richmond Wharf, Nine Elms, London, every Monday afternoon.



The process of making tiles by this machine, is as follows: a quantity of material sufficient to fill the box, or mould, is thrown in as in the ordinary process, and the surplus cut off even with the top, by a scraper of any convenient form or material. The end DD, and the frame or hoop FF, are then removed, and the workman (who stands at the end Z of the machine) takes the cylinder H H by the handles, and raising it up vertically, rests it upon the top of the box, or mould, with the rings, or guides *a a* upon the said cylinder outside, or against the outer face of the sides B C, thereby causing the wires attached to the cylinder H H to be brought against the face of the material left exposed by the removal of the end D D. The cylinder H H is then drawn along the top upon which it rests, and the wires are made to pass through and cut the material into the required number of tiles, according to the arrangement of the wires upon the said cylinder H H. The wires are thus brought through the material to the cuts or openings in the end E E, and over the roller L L in the grooves of which they are received and left.

The material being now completely separated into the required number of parts, the side B is laid down upon the table or bench A A (which is made wider at that end to receive it), the board G G, with the material upon it, is drawn out between the guides J J, and the tiles are taken to be horsed or otherwise, as may be expedient.

ON COLOUR AS APPLIED TO DECORATION.

By Hyde Clarke, F.L.S.

(Continued from Vol. IV. page 409.)

In the last volume I gave an analysis of the principal colours, and pointed out their several properties, reserving for the present occasion those observations which refer to the practical application of this knowledge in decoration, for which purpose I shall avail myself of the labours of Chevreul and Hay. The former writer has, indeed, treated the subject extensively and minutely; Mr. Hay, attaching himself to the elementary portion, which has been seriously neglected here, has only discursive notices scattered through his pages. A complete work on this subject is, in fact, one which yet remains to be written in English, although very much wanted, particularly at the present period, when attention is so much directed to decoration.

It has been before observed in the Journal, that there are two modes of composition, one in which boldness of effect is sought, and the contrasting or harmonizing properties of colours are made use of, and the other in which softness being the object, the architect or decorator avails himself of their melodizing properties. The next consideration after this in a regular composition, is the choice of a key colour, that is of the colour which is intended to preponderate in the arrangement, and to which all the others are to be adapted. Of course, in practice such a regular method can seldom be followed, and it is then that the ability of the artist is called into requisition to make the most of his materials. Limited as I am by the nature of the plan I have laid down, I cannot enter into this subject at any length, but it may be some guide to the student if I call his attention to some of the most glaring errors, which too often beset our artists, and upon which Mr. Hay so strongly dwells in his Laws of Harmonious Colouring. On the side of contrast these are the preponderance of some striking colour, or the deficiency of strength of the balancing colours; with regard to compositions in melody, we too often have to witness absolute monotony, or else the want of media to unite the leading colours employed. Another fault is confusion arising from inattention to the key colour.

Having dismissed these preliminary remarks, it will be our duty to consider the subject first as it regards decoration generally, and then as it concerns the several apartments, or as it influences the choice and arrangement of furniture. In the first instance we shall have to consider what is the aspect and the kind of light to be employed: for if we have the warm tones of the summer sun from the south and west thrown into an apartment, coolness must be preserved; but if we have a wintry aspect or morning light, recourse must be had to warmth of colouring. Where artificial light is used on a large scale, deep colours must be proscribed, and pure yellow, purple, green, and orange used with great moderation, all the former from being deteriorated, and the latter one because it becomes too glaring. Where rooms are lighted so that the direct rays of light are thrown entirely upon the floor, and the walls left comparatively in shade, a bright scarlet has been known to produce a good effect, the want of direct light preventing it from obtruding upon the eye (Hay, p. 51). In such cases, deep toned colours must predominate on the carpet, and gilding may be advantageously resorted to. If the artist has to consult the ladies in his arrangements, he finds that the tints of red, orange, and purple are all disadvantageous to the complexion, and that yellow, light green, or light blue, are among the more favourable, and then whitish and grayish tints. White may be advantageously used in decoration as a prevailing colour, when lowered in tone, and light marbles, gilding, sky blue silk, and satin wood furniture, used with it. Yellow, when pure, cannot be used in a large mass, but when lowered in hue is agreeable; when yellow is the prevailing colour, the tone of the accessaries must be heightened, it does not agree very well with gilding. Red requires that the general tone should be warm, and cannot be used in large masses, although it is a good key colour. Bright green should not be used with it, but green, approaching more to an olive tone, also russet and brown. Into such arrangements gilding may be introduced with happy effect. Blue, requiring coolness of character to be preserved, is a very advantageous colour, particularly when light; it agrees well with gilding and mahogany, but must not be used with pink. Orange is a good key colour, and although not a favourite, may be advantageously used; masses, however, must be avoided. It requires a warm tone. When used, blue must be kept subordinate to it, and this subordination in intensity ought to be in shade rather than in tint, or by neutralizing the blue by an admixture of a small portion of orange. In this arrangement black and white must be left out, russet, citron and brown should predominate, being occasionally relieved by the deepest shades of indigo (Hay, p. 47). A bright yellowish green agrees very well with mahogany and gilding, and with light tints of lilac or pink, and with it orange may be employed in small masses. Mr. Hay recommends with bright green, for any light, an arrangement of cream colour, French white, gilding on the cornice, ceiling and wood work, with damask hangings of giraffe and gold, and a suitable carpet. Where this arrangement is inverted, he says, when the hangings and chair seats are green, and the walls of a warm colour, the effect is equally beautiful in day light, but in artificial light it is injured. Bluish green requires a cool tone, as does gray. Crimson requires a warm arrangement, and on account of its good effect with gilding, is much used. Lilac and pink are considered to require coolness, and brown, warmth.

Directing our attention to the mode in which the uses of the several apartments guides the artist in his treatment, we should observe, that the drawing room being the scene of gaiety, vivacity and brilliancy should prevail, and that there the artist has his greatest scope. This vivacity, says Mr. Hay, is produced by the introduction of light tints of brilliant colours, with a considerable degree of contrast with gilding; but the brightest colours and strongest contrasts he recommends should be upon the furniture, the walls being kept in due subordination, but at the same time partaking of the general liveliness (p. 36). The dining room should be warm and rich, the furniture solid, and gilding not too prominently introduced. If coolness is wanted, as in a summer residence, blue may be made the key colour. A bed room should be light and cleanly, to produce which white and yellow may be used, and on account of the bed and window curtains forming a sufficient mass to balance tints of equal intensity on the walls, brighter and gayer colours may be introduced on the carpet, and a greater degree of contrast on the walls (Hay, p. 37). A library should have an air of repose, and yet a solidity of character; grandeur being produced by that amount of richness of colouring which is sufficient to banish monotony. With picture galleries, ornament and gilding should be sparingly applied as they tend to injure the effect of the pictures; for the walls, crimson, buff, and salmon are the tints that are preferred. In galleries of sculpture a pearl gray brings out the marble or plaster figures, although, if they are of a reddish tinge, the walls may be painted chamois or orange gray. Some sculptors like to produce a bright light on their figures, and then a grayish blue must be applied. Green has not a disagreeable effect, the statues taking a pinkish hue. For halls, vestibules, staircases, and lobbies, where breadth and extent are desired, coolness of tone must be preserved.

It will now be requisite to trouble ourselves with some few of the many details, in accordance with which the decorator has to combine his designs, or render them subordinate. For clearness I shall distribute the short remarks I have to make upon these subjects in distinct paragraphs, regretting that it is not in my power to enlarge upon them to a greater extent.

Stained glass can only be used with the medieval styles, and must not be mixed with plain glass; neither should the designs upon it be complicated. Engraved or embossed glass, when used on a large scale, has rather a dull effect.

Gilding cannot be used in every situation. nor combined with every colour, as yellow, but has a good effect with blue, light green, or crimson.

With regard to paper, as that forms the groundwork of the design, sufficient has been said in the general remarks to require no further notice, except to point out the mischief which is done in choice of this as well as of other articles by the selection of patterns which, however good when looked at on a small scale, are obtrusive when forming a mass.

Hangings and coverings of sofas and chairs require great management. If the wish is to contrast them with the wood, purple or blue stuffs are of course used with yellow woods, and green stuffs with red woods. Bright red colours, as scarlet, &c., must never be used with mahogany, as they lower the tone of the wood, making it look like oak or walnut. Where gorgeousness or splendour is desired, the hues of orange, as gold or giraffe, do very well for window curtains, chair seats, &c. In silk, bright blue is very pleasing, and black is also effective in that material; with regard to worsted, however, although blue and its various shades are equally useful, black is very apt to be sooty and heavy.

As a room is never too light, and as the light may be diminished by blinds or venetians, and as at night-time artificial light is used, hangings should be of a clear and not dark colour, so as to reflect light instead of absorbing it. When used in masses the deep shades of all colours should be avoided, as absorbing too much light; red and purple as unfavourable to pink or lilac; orange, as before mentioned, from being too intense. Yellow, only, and bright blue and green, are really effective; yellow, as being gay and suiting mahogany, though not gilding, blue; as favourable to gilding, not injurious to mahogany, agreeing better with yellow or orange woods, although unfavourable to pink in day-light; green, as being advantageous to pink, and to mahogany and gilding.

Carpets have great influence in decoration, for in daylight they receive the rays of light more directly than any other part of the furniture and decoration. On this part of the subject Mr. Hay has many useful notes; he recommends that in carpets green should always preponderate, as it is most pleasing in daylight, and also relieves other colours, and harmonizes with them in its various hues, more generally than any other colour does. Its bright and vivid hues are easily neutralized, and seldom produce crudity or harshness of effect, while its rich and deep tones, especially when neutralized towards a tertiary hue, citron or olive, harmonizes with and give value to all denominations of warm colours. Thus far Mr. Hay; he further says that its cooler hues and shades ought to be used with more caution, for they are apt to appear blackish and heavy, although the blue predominates in them to the same extent that it does in the hues of purple called indigo, yet they have not the same clearness. In carpets, bright yellow, red, or scarlet should not preponderate, as they are apt to catch the eye, and so spoil every thing else which it afterwards looks at; black and white must be used with equal caution, and, indeed, at present their indiscriminate introduction is one of the greatest defects of the modern manufacture. In the finer specimens of Persia and Turkey we find the deep tones of indigo and brown predominating, while the bright hues and tints only appear to point out and heighten the effect of the pattern. Below indigo, marrone or brown, the deepest shades used in this manufacture should never go, and the highest tints are recommended to be mellowed down with some warm colour. White, when introduced, should in like manner be toned down by a gradation of the lightest tints, so as to avoid the appearance of being spotty and broken. When employed as the groundwork, white should be reduced in intensity, and where red and yellow prevail, it should be raised to a cream colour. When, however, the tone is cool, blue or green being the prevailing colour, the authority which we have already so frequently quoted, recommends that the white should be tinged of a gray or purple, or any other cool tint or shade. Of course when white is used as a contrasting colour and not as a medium, it should be tinged of a warm hue. Orange, when used in a carpet as the key colour, requires that the blue should be subdued either in quantity or intensity, and neutralized by the introduction of a small portion of orange. When orange is so used, russet, citron, and brown should be employed as the medial hues, occasionally relieved by the deepest tones of indigo. Here black and white are particularly out of place. Russet is particularly useful in all arrangements which are adapted for carpet patterns, and so is indigo from its strong contrast to bright yellow, while it dyes well, being clear and free from sootiness. Mr. Hay points out, as a particular error in the designing of carpets the introduction of deep and pale colours, which may have been well chosen with regard to their hues, but not as to their particular degrees of strength or tint. Thus a pale tint of blue is often introduced as an equivalent to the brightest orange, and sometimes a small portion of lilac or pink as a balancing colour to a quantity of the most intense yellow.

What has been said as to hangings, &c., bears upon the subject of wood furniture, for covers and seats must be made to accord with the wood. In contrast, green stuffs must be used with red woods, as mahogany, &c., and purple or blue with yellow woods; in melodizing the woods a contrary course must be pursued. In this kind of arrangement particular care must be taken that the tones are brought to a corresponding degree of intensity, for which much skill is required. With regard to mahogany, with which the decorator has so frequently to deal, it may be regarded as a russet or red, and we have already cautioned him not to use bright red colours with it, as crimson, &c., nor orange or purple reds, as scarlet, &c., for the brightness of these colours subdues the colour of the wood, and makes it look no better than oak or walnut. Oak may be considered as a citron.

With regard to pictures, I have, when speaking of picture galleries, sufficiently shown what grounds to use with them; as to frames, something further may be said. Gilt frames are preferred with large oil paintings, and also with dark engravings, and lithographed portraits when a sufficient white space is left around them. Bronze frames do well with oils representing scenes lighted by artificial light. By using coloured frames, pictures are very much modified in appearance. Black weakens the shades, and bright tints suffer more than half tints, while for lithographs the red of the ink is rather raised than lowered. Gray does not weaken the bright tints and half tints, but then it does not raise them so much as white, while it gives them a reddish cast. Gray has the singular property of giving a perspective harmony which is possessed neither by black nor white, and orange has an effect directly opposite. Red reduces the red tones and gives a greenish hue. Green weakens browns, but heightens other tones, and is agreeable on the whole. Blue has the strongest effect with lithographs, giving them a bistre or sepia colour.

For bronzes those of a dark green colour require a red ground, and when light coloured and new, a bluish ground.

REMARKS ON SHIPS OF WOOD AND IRON.

Remarks on the relative advantages of the employment of wood and iron in the construction of ships have appeared at different times, in Journals devoted to inquiries relating to subjects of this nature, but a spirit of partizanship has been commonly displayed by the respective advocates of wood and iron in favour of their own views. In an endeavour to avoid this charge, it will be expedient to advert in the first instance, to the different modes in which wood can be employed in ship building, especially as the advocates of iron are in the habit of referring to the defects of ships built of timber, which are capable of being obviated by a different system of construction.

The relative merits of wood and iron for this purpose will, I apprehend, come more fairly before the public by an exposition of some of the plans that may be adopted in the construction of ships of wood; and it appears to me that three well marked systems may be distinguished. 1st. The common plan of timbers, whether framed or single, separated by spaces from each other, whose principal connection with each other, arises from an external and internal series of planking. 2nd. The plan used in her Majesty's dock yards, of timbers wedged up solid, and covered by an external planking, (timbers placed close together I conceive would be found to be a better method.) 3rd. A plan of constructing vessels of any size by two or more connected series of planks without timbers; this method has not been extensively used. Clinker-built boats belong to this third system, and perhaps also iron vessels, inasmuch as the plates of iron of which they are formed are of far more importance than the iron ribs, which occupy the position of timbers.

The advocates of iron have, I apprehend, by no means exaggerated the defects of ships of the common construction, in which the connexion of the timbers with each other is extremely imperfect, even in the best built merchant ships, and the safety of the largest vessels is dependent on the security of the fastenings of the butts of a 4-inch plank.

I consider these defects are so fatal that no increase of strength or improvement in workmanship can more than palliate them in a greater or less degree, and I propose to abandon any reference to these vessels, and at once admit their inferiority to vessels constructed of iron, provided the latter are made of sufficient strength.

A large proportion however of the present enormous annual loss of merchant ships seems to have been sufficiently traced to defective methods of construction, and to the facility it affords in covering the defects of cheap ships; still the causes that tend to foster the continuance of the present system are subjects foreign to the tenor of these remarks; the fact that the rottenness of the timbers can be concealed from casual inspection, is sufficient for our purposes. It has been urged that unless spaces are provided between the timbers, for the accommodation of water from leaks, that it would rise in the vessel and spoil the cargo. This argument is founded on the assumed necessity of leaks, but it affords proof of their frequent occurrence in vessels of the usual construction.

The rapid destruction of timber by the united operations of wet, heat and filth, and the generation of foul air from these causes will not be denied; and in addition to its weakness the rapid deterioration of the frame of the vessel, from the above causes, seems an equally fatal objection — though exceptions may occur owing either to care or accidental conditions.

The second system of ship building with timbers wedged up solid, has been in use for a considerable period for ships of war, and the success that has attended this plan has been amply proved by the accounts of the escape of different vessels, that have since its adoption been driven ashore and got off again, in many instances without injury, and in other cases damaged to such an extent as would have insured the total loss of vessels of the common construction; for instance, the *Pique* lost a large portion of her keel, and in some places the whole of the garboard strake, and a part of the floor timbers were ground away by the rocks of Newfoundland, and yet this frigate crossed the Atlantic without a rudder, under circumstances, it must be admitted, of some anxiety to the officers and crew.

For merchant ships I should propose to use the same weight of materials as are now employed, the outside planking would remain without alteration, but the quantity of wood in the ceiling would be added to the width of the timbers, and in case it was insufficient to fill up the spaces between the timbers, the depth of the latter must be lessened to make up the deficiency.

Under these circumstances the timbers would be about double the thickness of the outside planks, and being placed close together, a good means of connexion might be obtained by large dowells or coaks, so as to produce a mutual dependance on each other, and so that any pressure on the outside would exert a more regular strain on every part. A vessel constructed on this principle would be an irregular cask, and when caulked inside and outside would float without planking; and by the addition of the latter, a frame of great stiffness, and equal strength and thickness in every part would be obtained, on which one side of every piece of wood used in its construction would be visible, and would allow an examination to be made of its state with great facility. The other sides of the wood would be preserved from wet as long as the fabric of the vessel remained sound, and the caulking was attended to. It is obvious that a greater inside width of 7 or 8 inches would be gained in these vessels, and no loss of space would accrue if it was occupied by battens to admit of water accommodation for the leakage, and the prevention of injury to the cargo from the escape, until at least the present advocates of the assumed necessity of leaks in ships, became convinced of the small prospect of their occurrence under common circumstances in vessels so constructed.

It is true no provision will afford security to vessels on rocks among breakers, but such situations afford the best test of the merits of different systems of ship building, by the time each vessel is found capable of resisting these effects.

Numerous cases will occur where life is dependent on the time the vessel holds together, but the partial saving of the cargo may be considered objectionable by ship owners, among whom the advantages of a total loss are well understood. Opinions on these points are of little value, we must wait for evidence from wrecks under different conditions.

The scantling proposed for merchant ships would, I apprehend, be not quite so heavy as that in use for ships of war of equal size; at the same time, it is probable that the strength of timbers placed close together, except that of the dockyard plan of timbers wedged up, to such an extent that a greater strength may be perhaps obtained at a smaller cost. Plans of this nature are obviously only suited for good workmanship and good materials; but it ought to suit, for less insurance premiums, whenever an inquiry on this subject is properly conducted, and explanations are afforded to insurers of such a nature, as shall be fully understood.

The third plan referred to, requires similar conditions of timber and workmanship, but it has not been extensively adopted. Ten or twelve series of inch planks were employed many years ago, in a 500 ton vessel built at Rochester, but I conceive three or four series of 2½ to four inch plank, according to the size of the vessel, would be found a more convenient method of construction.

Several of the Gravesend steamers of 150 feet in length have been built of three series of 1½ inch planks, and they have run for 4 or 5 years, and are now said to be as sound as when first constructed, such at least was the case with the Ruby, when opened for the purpose of lengthening the bow to increase her speed.

This method however requires farther trial, especially at sea, before any decisive opinion can be given on its comparative merit; it is favourable to soundness, as the necessity of sawing the wood into planks admits of the certain selection of good materials, and would afford great facility in seasoning timber properly. While the expense of selection would in some degree be lessened by the conversion of the rejected planks to inferior purposes, or by working it up in inferior or cheap craft, perhaps for river use. The increase of cost would not answer unless it was accompanied by a proportional increase of durability, and perhaps the general opinion would be in favour of the latter result, as a necessary consequence of the selection of good timber.

The launches used in the navy have for several years been made on Johns' plan, of two series of planks crossed diagonally, their weight is about ⅗ of the boats of the old construction, and their durability has been much increased. The Gravesend steamers are built with two similar series of crossed planks in lieu of timbers, covered with an outside planking in the common mode, the whole well fastened with copper.—in large vessels perhaps a ceiling connected in the same manner might be deemed advisable: at the same time it seems probable that a greater strength would be obtained by a less quantity of timber in the third than in the second method of construction proposed. Clinker built which belong to this class, in which the principal strength depends on the planking instead of the timbers, seldom exceed 100 tons in size, and are usually of a slight scantling; their great durability is well ascertained, provided they are kept from the ground, in which case from the thinness of the single part of the planking, holes are easily knocked in their bottoms.

The introduction of these methods of constructing timber ships is not likely to be effected, except by the nearly total destruction of the present trade in ship building, by the more general adoption of iron vessels, and the interests of humanity will cause the earliest occurrence of this result not to be regretted. Nothing perhaps but the severe pressure of iron competition will induce the present race of ship builders to turn their attention to the means whereby greater strength, security and durability may be given to wooden ships; eventually perhaps its greater strength for a given weight, and its greater elasticity may obtain a preference.

Prime cost undoubtedly will form a principal element in the approaching competition; at present iron vessels are often built too cheap, or in other words too slight; the error may be, and I believe has been remedied. Innumerable questions will arise relating to the elasticity, strength and durability of wood, as well as its quality; and also in reference to the destructive action of salt water on iron, the strain on the rivets, &c. &c., which can only be answered by experience.

To a spirited competition between wood and iron I look for the improvement of vessels of both materials. Recently I have met with parties who being engaged simply as owners on the proposed construction of a steam boat, in consequence of the difficulty in the choice of wood or iron, have found it necessary to institute an inquiry respecting their relative merits in ship building; these parties, but for the difficulty of selection, would have gone on in the good old jog-trot way of supposing, that British ships of the old construction were perfect specimens of the art, and would have patiently submitted to the present rates of insurance, as founded on the average loss, deduced from defective ships. The spirit of inquiry once roused among owners of shipping, will I trust lead to results as yet scarcely anticipated.

It matters little to the country whether wood or iron eventually obtains the preference; if British oak is abandoned it will be only superseded by British iron, and the inhabitants of our land ought to be satisfied if the latter will uphold the character of the navy as well as the former has done.

At present I consider the question of relative superiority as undecided, and though disposed to admit the inferiority of timber vessels of the common construction, yet the advantages of iron may not exceed that due either to the methods of construction adopted in the navy, or in the Gravesend steam boats. The latter method is perhaps best adapted for small, and the former for large vessels. Moreover, we want the evidence likely to be afforded by the wreck of the largest iron steamers, for the formation of an opinion respecting their powers of endurance under the breakers of a rocky shore, or a sand bank.

In regard to the relative advantages of the two plans of ship building proposed for the merchant service, the method adopted in the navy has received the stamp of experience, and the evidence is conclusive in its favour. The 500 ton vessel built of planks before alluded to, was driven on shore in a heavy gale under Mount Batten, in Plymouth Sound, when loaded with Ordnance stores, in company with 10 or 11 other vessels, all of which became total wrecks; she afforded an almost solitary instance of a vessel saved, when ashore on that point, and she is reported to have rebounded from the rocks for a short time like a cask, until a hole was knocked in her bottom; after the gale she was got off, and was repaired at a moderate expense, and proceeded on her voyage to the East Indies.

I should also be inclined to the opinion that a greater strength will be obtained with a less quantity of materials, by means of several series of planks than by close timbers and outside planking, but the latter plan seems to afford greater facility for repairs. In conclusion, I would remark that it is my object to assert the possibility of the introduction of great improvements in the construction of vessels of wood, without any increase, and perhaps at some reduction of cost, and I wish to induce parties engaged in ship building to advert to the fact, that the best portion of their business, the construction of steamers is rapidly passing out of their hands, and that unless sailing vessels are rendered stronger, safer, and perhaps lighter, this portion of their trade may follow, as the establishments for building iron vessels are increased, or at least such a depreciation of prices may occur as will be equally ruinous to them.

At the same time I must acknowledge that great improvements in regard to strength have been necessary, and have been adopted in many of the larger steamers, in some instances perhaps to the full extent here advocated, at least in the engine room; similar principles might be adopted in the fore and after bodies with lighter timbers, and hence a less strain would be thrown on the midship body in passing over heavy seas. It is their general adoption that I would urge, and I cannot but express my conviction that steam ships of the largest class yet made, may be constructed to bear the winter seas of the Atlantic, by a better disposition of the timber employed in their construction.

Y.

HAS ATLANTIC STEAM NAVIGATION BEEN SUCCESSFUL?

ALTHOUGH practical men are usually ready to acquiesce in those deductions of the philosopher which relate to the establishment of abstract principles, they are too apt to resist any attempt to apply those principles to the analysis of the transactions of real life. General truths are usually treated as if they were individual fallacies: and a hypothesis however just, requires to continue inert in order that it may remain uncensured. All men look upon general rules as being applicable to all cases except those in which their own antipathies or predilections happen to be enlisted, and however clear men's judgments may be upon indifferent topics, they appear incapable of apprehending the force of the plainest argument if establishing a conclusion adverse to their supposed interests. Hence the imperfect success of attempts, to fix the current value of political or commercial measures by the aid of philosophical research. Some powerful vested interest is sure to step in to prove, "by most sufficient reasons," that the subject under inquiry is exempt from ordinary jurisdictions—that its peculiar features constitute it a case *sui generis* which the said vested interest is by far the best qualified to illustrate. Truly the public has much to be thankful for, from an intervention so discriminating and disinterested!

But the philosophers are sometimes censurable also. There is a philosophical as well as a popular infatuation, the former consisting in unwarrantable generalization, as the latter in irrational speciality. Things alike are yet things different, and although in the generic distribution of a subject it is impossible to take cognizance of minute differences, yet those differences must by no means be disregarded when an individual case is singled out for examination. Philosophers are too apt to pay exclusive regard to leading characteristics—to overlook those limitations and peculiarities which distinguish everything in nature from that which it most nearly resembles, and without an attention to which, general rules cannot be rendered strictly applicable to the diversified cases which arise in practice.

The obvious remedy for these evils is for the practical man and the philosopher each to abate somewhat of his characteristic prejudice. Let the practical man trust a little more to reason, and the philosopher a little more to experience, and let the practical man take the proper steps to cure himself of that mono-mania which the intermingling of considerations of private interest with philosophical investigation usually generates. He should adopt the synthetic rather than the analytic method of investigation, and should be more intent upon tracing resemblances than upon multiplying distinctions. He should reason from principles to examples rather than from examples to principles, and should rather regard principles as the exponent of results than attempt to raise results into an antagonism of principles. The philosopher should carefully examine whether the case he has undertaken to investigate be not an exception to a general law—or whether it may not possess such distinctive qualities as may materially modify the final result. He should ascertain the precise point at which the case under review diverges from other cases the most nearly coincident, and should assure himself that he has overlooked no circumstance capable of influencing his conclusions. It is only by an observance of these rules that either practical or scientific men may hope to obtain results undistorted by prepossession, prejudice or passion, and we should hope to witness the adoption of these means of arriving at a correct conclusion in the investigation of the merits of Atlantic steam voyaging, were it not an invariable attribute of keen disputations that the attainment of a correct conclusion is regarded as matter altogether unimportant.

The clamour and confusion which marked the original discussions relative to Atlantic steam voyaging have now happily subsided, but although they made such an unceremonious noise, they have left no very distinct recollection as to what that noise was all about. In truth it was not very easy to tell that, even at the time: for so much of palpable absurdity was mixed up in the doctrines currently attributed to the most distinguished of the disputants, as to destroy in the minds of men unaffected with the steam *rabies*—all confidence in the genuineness of the imputed declarations. Men of penetration indeed regarded the representation that suppositions pregnant with absurdity were the sentiments avowed by eminent inquirers, as a sort of *ruse de guerre* intended to shake the reputation of those whose arguments were unsusceptible of refutation. But the manœuvre was successful—the advocates of the Atlantic enterprise were "willing to swear any thing for their client," and the faith of the multitude was equally comprehensive. Many of the absurdities so industriously disseminated as the sentiments of distinguished men, were really in some measure believed to be the veritable doctrines of those eminent persons, and of those who rejected such a supposition, but a small proportion was aware of what the actual doctrines really were. We have been at some pains to supply this defect of information from authentic sources: it is our present purpose to state,—1st. The nature of the opinions really entertained upon the subject of Atlantic steam transit antecedently to its establishment; and, 2ndly, The present condition of the Atlantic enterprise, restricting the meaning of that term to the line of communication between Great Britain and New York, to which it was originally applied.

The discussion of the question of Atlantic steam transit first attracted the public attention during the meeting of the British Association, held at Bristol in 1836. One party alleged that the establishment of a line of steamers between Great Britain and New York, of sufficient size and power to enable them to perform the passage IN ONE TRIP, would inevitably be a most beneficial speculation. Another party, of which Dr. Lardner was the representative, contended that there were no good grounds for believing that the performance of the voyage IN ONE TRIP was practicable, with sufficient economy to render the enterprise successful; but that if the voyage were resolved into suitable stages, the enterprise might then be brought under conditions which promised a fair prospect of a beneficial result. To understand clearly the force of the reasonings, we must first have a clear conception of the capabilities of steam navigation.

If any given steam vessel, moved according to the ordinary practice, by the conjoined agency of steam and sails, be laden with coals to the extent of her capacity, she will in that state be capable of performing a voyage of a certain determinate length, with her engines acting for the whole time at their full power. Now it is well known that the same vessel is capable of making the same voyage by the agency of sails alone, for although steam vessels when propelled by sails alone, without working their engines, may be inferior in speed, or in nautical qualities, to an ordinary ship, yet we know that they are capable of performing long voyages unassisted by steam, as has been abundantly proved by the voyages of the Madagascar and other steam vessels to India, as well as by numerous government and other vessels. Between the performance of this voyage with the greatest expenditure of fuel, which will in ordinary circumstances be when the engines are worked at their full power, and with the expenditure of no fuel at all, we may manifestly fix upon a given point where the expenditure of fuel during the voyage shall be precisely what we please. For we may either work the engines during the voyage for such a proportion of the time as shall exactly consume the quantity of fuel we have fixed upon, or we may work the engines for the whole period of the voyage, with such a diminished exertion of power as is capable of being produced by the quantity of fuel we propose to consume. We may therefore easily maintain the machinery of a steam vessel in uninterrupted action for any length of voyage we think proper, provided only that the amount of power exerted by the engines be correspondingly diminished, or what is the same thing, that the engines be, if worked at their full power, corresponding small. The question therefore of the practicability of a steam voyage of any length whatever, resolves itself into the practicability of making ships very big, and engines very little; a question which can hardly be supposed any one should be so insane as to contest. Yet even this absurdity has been attributed to Dr. Lardner, who is represented to have said at the Bristol or Liverpool meeting of the British Association, that for a steamer to reach America was a physical impossibility; and this too in the face of the well known FACT that the steamers Savannah, Curaçoa, &c., ***had already*** crossed the Atlantic long antecedent to the date of the Bristol meeting! And was a falsehood so preposterous believed? It was—and is probably extensively believed to the present day. But it will be objected, "Dr. Lardner said that we might as well attempt to establish a steam communication with the moon as with America." If Dr. Lardner ever made use of any such expression, we presume he only meant to intimate that the Atlantic enterprise was in his opinion a visionary one. When we talk of a bubble speculation, we do not in general mean that the said speculation has reference to the manufacture of hollow aqueous spherules—or if we speak of sunset or sunrise, we are not usually interpreted as expressing our disbelief of the Copernican system—so in like manner if we institute an analogy between any given enterprise and a tunnel through the earth, or a railway to the moon, we are usually understood to express our belief that it is of a very hopeless character. Of physical impossibilities we rarely venture to speak—the subject is abstruse. We should not be warranted in saying that *in rerum natura* it was a physical impossibility to bore through the earth, or with the assistance of photography to have a telegraphic communication with the moon, yet we are warranted in treating projects such as these as "trifles light as air," and in associating by a common figure of speech, projects of which we would express our disapprobation with these unsubstantial fantasies. It is difficult to discover upon what principle Dr. Lardner is to be deprived of the use of the universally employed language of metaphor, or why a doctrine is to be forced upon him which every man in his senses must utterly disavow. But it appears obvious to us that no very figurative acceptation of the expression attributed to Dr. Lardner is necessary, as will appear plain enough from the following considerations.

The mere abstract practicability of performing voyages of any length whatever by steam vessels is so palpable that it cannot require another remark. But in practice other considerations arise. The vessels must be of a sufficient power to ensure a rate of progress considerably superior to that of sailing vessels, and they must be so capacious that whilst furnishing sufficient stowage room for coals, they will render comfortable accommodation to passengers, and space for a moderate quantity of cargo. These questions being satisfactorily disposed of, another question of still greater consequence presents itself. Will vessels of the size indispensable for long steam voyages, of adequate power, capacity and accommodation for the navigation of the track of ocean between Great Britain and New York in one unbroken voyage, PAY THE PROPRIETORS? The question of success or failure is sooner or later merged into the question of profit and loss.

The profit or loss of steam voyaging is manifestly a function of a multitude of local and individual circumstances, which are incapable of reduction to any general form of expression. But *cæteris paribus*, the longer the voyage is without relays of fuel the more remote becomes the prospect of a successful result. For in proportion as the length of the voyage is increased, the size of the vessels suitable for the performance of that voyage must be increased in a corresponding, though not in the same ratio, and the expense of maintaining steam vessels of such power and tonnage as to be adapted to the performance of unusually long voyages, is such that scarcely any line of independent unprotected traffic is sufficient to sustain it. It may hence be safely assumed as a general principle that in cases where the only sources of revenue are the profits upon freights and passengers, and the peculiarities of the voyage at the same time demand the employment of steam vessels of similar size and power to those constructed for Atlantic voyaging, the success of the enterprise, that is, the continuance of a profitable and satisfactory issue, will be, to say the least of it, as is proper in a case judged *à priori*, exceedingly problematical.

The limitation which exists to ocean steam voyaging is *expense*, not *impracticability*. This limitation is in the present state of the art immoveable and insuperable, and the establishment of a steam communication with the moon, is quite as feasible as the profitable extension of steam voyaging in the present state of the art, to cases to which it cannot be profitably extended. The attempt to surmount difficulties by shutting our eyes to them, is not merely futile, but is in this case productive of unmerited disfavour towards steam navigation. For the origination of enterprises, which from their nature cannot be capable of yielding an adequate profit to render them permanent, destroys public confidence, and fearfully represses the spirit of commercial adventure. There is no achievement which ought to be more grateful to the public acceptation than the analysis and exposition of such illusive enterprises, yet there is none which frequently obtains a more ungrateful requital. Persecution and calumniation appear to be the heritage of the public benefactor, and the same dark spirit which administered the poisoned cup to Socrates and Phocion, is not extinct at the present day. Yet it is the part of philosophy to bear contumely without depression—nor ought the sensibilities of the philanthropist be frozen by the breath of popular aspersion. If it be beneficent to attempt the dissipation of popular delusion, to continue that attempt unmoved by calumny, violence and derision, is surely an approach to divinity. We trust that Dr. Lardner may long continue his patriotic endeavours to direct aright the national energies in any questions similar to that which forms the subject of the present enquiry. Those energies if suffered to run to waste will produce a vegetation which may be fair for a season, but which will inevitably prove itself to be deadly and delusive. Like waters poured out in the desert, they may cherish flowers pleasing to the eye, but bearing death in their exhalations—trees of luxuriant foliage and majestic stature, but hollow and poisonous within; fruit of tempting appearance, but turning in the grasp into bitterness and ashes. With the view of assisting our readers to form a correct estimate of the true character of the Atlantic enterprise, we shall recapitulate some of the circumstances attending the discussion of that question. The asperity which characterized the discussion at Bristol, as well as the subsequent discussions at Liverpool and Newcastle was a prominent feature of the inquiry, the more so that it happily rarely attaches to statistical and philosophical investigation. The cause of this unbecoming heat has been attributed to the fact of considerable interests having been already enlisted, antecedently to those discussions, in the schemes which Dr. Lardner found himself constrained to condemn. The managers and directors of these several embryo projects were, it is said, in conformity with our opening exposition of the besetting frailty of practical men, incensed at the application of Dr. Lardner's general conclusions respecting steam voyaging to this particular case, which they contended ought to be and was an exception. It was considered that the clearness of Dr. Lardner's expositions established a conclusion opposed to their interests, and involved an indirect reflection upon their capacity or disinterestedness, whilst engineers and other artificers were not without that bias in favour of the Atlantic enterprise which the anticipated fabrication of immense vessels might be expected to create. Though unable to cope with Dr. Lardner in argument, this united party reasonably concluded that Dr. Lardner was entirely wrong, because they were undoubtedly entirely right. They therefore attempted, and not without some temporary success, to undermine his reputation for practical sagacity, by attributing to him sentiments he never entertained, and then showing those sentiments to be altogether fallacious. When the phantoms thus arrayed, as if they had been real entities, had been valiantly slain, the victory was manifestly won, and was so adjudged by "a discriminating and enlightened public." That the popular voice should have adjudged to the advocates of the Atlantic scheme the superiority in the discussion of that question is a circumstance which has been supposed to be partly due to the effect which *any* doctrine is capable of creating in the public mind if incessantly insisted on, but chiefly to the contemporaneous development of the most extravagant popular anticipations relative to steam agencies. This species of delusion has been not inappropriately termed the Steam Mania. During the severity of its paroxysms, projects the most preposterous were received with eagerness and applause, the country was drunk with expectation, and for a time appeared bereft of every atom of its accustomed discretion. In so distempered a state of the public mind the project of Atlantic steam voyaging could scarcely fail to attract numerous admirers. The magnitude and grandeur of the enterprise captivated the popular sympathies, whilst the implicit faith in the omnipotence of steam agencies smoothed down all difficulties and surmounted all opposition. But although enthusiasm may win a battle, it is only the material interest of mankind which can keep the field. Reason may be overborne for a season, but is sure sooner or later to obtain the superiority. A few years of experience generally brings with them the subsidence of the most inveterate popular delusions. Men awake as if from a dream, and it is an honourable trait in the character of public opinion that it has no resentments to perpetuate, but is desirous to atone for whatever injury its frenzy may have inflicted.

A very clever writer in the Quarterly Review, No. 123, (1838) undertakes to point out the magnificent prospects of Atlantic steam voyaging, and the advantages direct and consequential which may be fairly expected from it. The period at which this article was written, shortly posterior to the accomplishment of the first voyages of the Great Western, was peculiarly favourable for lending weight to the reviewer's conclusions, and the writer is evidently a man of much general ability.

We shall proceed to make extracts from this article, as an example of the arguments adduced in support of the advantage of the Atlantic scheme.

"The effect of this achievement is by no means easily to be described or foreseen. Even the Americans with all their reputation as a self possessed and considering people, have displayed unwonted raptures and antics on occasion of the first arrival of the Sirius and Great Western at New York, quite as much so as our Bristol neighbours on their return, and we are not sure that either party is to be blamed for it. We are not sure that the former are far out of their reckoning when they speak of this as a new epoch in the history of the world. We can enter into the feelings of the myriads who crowded the wharfs at New York, when the English boats were hourly expected, when finally after days of almost breathless watching (which to fearful spirits might well have afforded some pretext for disbelieving the new scheme, some excuse for casting even ridicule on it after all), at length on the morning of St. George's day, the doubts, the fears, the scorn were alike destined to be removed for ever from the mind of every living creature, (even, we dare say, but let us say it with due deference, from that of Dr. Lardner himself), for now appears a long dim train of distant smoke in a somewhat unaccustomed direction, it rises and lowers like a genius in the Arabian nights portending something prodigious; by and bye the black prow of a huge steam boat dashes round the point of some green island in the beautiful harbour

Against the wind, against the tide,
Steadying with upright keel."

It is not very easy to perceive what these doubts and fears really are which the first voyage of the Sirius was destined to remove for ever. The doubts and fears of the possibility of a steamer being able to cross the Atlantic? Dr. Lardner can hardly be conceived to have entertained these doubts and fear, for one small reason among many others, the passage across the Atlantic had been accomplished by a steam vessel about twenty years before. Are the doubts and fears meant to have exclusive reference to the profitable issue of the undertaking? How could the success of any enterprise in steam navigation be ascertained by the performance of a single trip?

"The British and American Steam Company who have just launched at Blackwall a ship thirty-eight feet longer than any in her Majesty's navy, notify to us moreover that next year they mean to have boats like this running on each side on the 1st and 16th of every month. This is but one company, one which has not yet moved we believe, for we understand the Sirius to have been sent out by another, and the Great Western it is well known belongs to Bristol. Glasgow too will no doubt bestir herself, and above all we must leave room for Liverpool. The sole marvel is that Liverpool has waited so long, a secret only to be explained by the extent of interest there invested in the American liners. We see that a company is now started at that port who announce immediate operations."

To us it appears still more marvellous that the establishment of Atlantic steam voyaging should have been accomplished by England *at all* when America had palpably the greatest benefit to receive from the execution of that measure. The Americans would it is alleged have taken a share in the Atlantic enterprises had they not built their hopes upon a project which was to send a ship across the Atlantic by the instigation of a barrel of blue vitrol, but which failed. This circumstance is however insufficient to account for the torpidity of the Americans, where there is anything expected to be won. Had the expectation of a profitable result been as sanguine in the United States as for some time it was in England, it is the opinion of the best informed persons that we should not have been left to enjoy the steam monopoly of the Atlantic. The fact appears to be that the Americans were better judges than we were of the amount of profit to be realized by the transport of passengers and light articles of merchandise across the Atlantic, arising in part from the experience they had had of Atlantic steam voyaging before we began. "Scarce ten years had elapsed after Fulton first committed his novel little pinnace to the waters of the Hudson, ere the Savannah, a new steam vessel of 300 tons crossed from New York to Liverpool, and at several subsequent periods has the voyage been accomplished. The reason why Atlantic steam voyaging has not grown up among the Americans may be traced to the conviction that the adventure would not be productive of that Honey of Hyblas, vulgarly called MONEY."[*]

The Quarterly proceeds—"What is to prevent a fair competition now? What account is to be made of a curve or two in a river with steamers of 300 feet long, and a speed of 15 miles an hour, as practical men best versed in these matters expect to see in a very few years? And indeed the American boats upon the Hudson have been running at much more than this rate for years." We confess we should like some verification of all this before we believe it. Our readers may try their penetration upon the following, which to us appears mere childishness.

"We were speaking, however, of the first sensation, the achievement has produced, and which we venture to predict will at some future day be a matter of no little historical curiosity. The New York editors seem scarcely able to contain themselves, 'side by side with the old world at last,' says one,—'Now then for the coronation,' cry half a dozen more—and then the files of European journals unrolled! Fifteen days from Bristol, &c. &c. A revolution this such as the world rarely sees even in our eventful age—a revolution thoroughly overturning the old systems of most of the business world at least—yet effected as it were instantaneously, and without one drop of blood."

The following is a magnificent example of that figure of speech usually termed nonsense.

"Some one has predicted that presently we shall have Covent Garden market stocked by the other continent; as to the floral department there may be something in it for aught we know, and indeed in some others too, for if the 'liners' could bring *the Duke* a present of fresh venison from his western admirers, we certainly get a clear vision here of divers good things to come. We say nothing however even of Yankee ice dropped in dog days at sun-rise upon every door step in London as in Boston—not one word—'*Nil admirari*,' we repeat, is our motto; 'keep cool,' that is, ice or no ice—dog days and all."

But further. "It is only thirty years since Fulton ascended the Hudson with his boat. In 1810 there was no such thing in all England, and as late as 1820 there were only thirty-five. The most important improvements also have been *very* recently introduced, and without particularizing these, it is sufficient to say that the learned Dr. Dionysius Lardner's miscalculations on this subject of Atlantic navigation, have evidently been caused by almost wholly overlooking these same improvements, even so far as some years past are concerned, (and a year in such a progress as this agent is making is a matter not to be overlooked), or regarding them too much as mere speculations not likely, or not yet fully proved to be capable of great practical effects (as they have already been), while as relates to what may yet be established, though now it is but experimental; or of what may be discovered of which nobody now dreams, the calculations in question have apparently left no lee way for the ingenuity or our successors, or even our contemporaries. It was taken for granted that all had been done which could be done—that there were not any 'hidden powers' hereafter to be brought to bear upon steam navigation, as well as upon other things, and to supersede steam itself altogether. How grand a mistake this was we need not say, let us beware of its being made again."

In reference to this statement it is proper to observe that Dr. Lardner's deductions relative to the Atlantic enterprise were formed, as we shall presently have occasion to show more in detail, from the performance of the Medea, and that the Medea was at that time the most perfect existing steam vessel in reference to the distance over which she might be propelled by a given quantity of fuel per horse power.

In regard to the omission of "lee way" in his computation, it is difficult to see upon what grounds the admission of such an element could be justified. Atlantic steam voyaging in the year 1836, either was or was not beneficially accomplishable. The point was evidently alone capable of being determined by a comparison of the difficulties of the enterprise with the existing capabilities of steam voyaging; and how were the existing capabilities of steam navigation to be ascertained except by a reference to the performances of the best existing steam vessels? If Dr. Lardner did this, he did all he was called upon to do; he was not called upon to say that Atlantic steam voyaging would be profitable in 1836, because the progress of improvement might perhaps render it so in ten years time, or in ten months time. It would have been highly unphilosophical to have based computations upon circumstances which were not really existent. No man can say that in any branch of science or art all has been done that can be done, but it is quite time enough to adopt discoveries when they have been actually found out.

Once more—"It cannot be doubted, we think, that the passage of the Atlantic by steam will even in the coming ten years be brought to a state of (so to speak) artistical luxury and perfection, of which those who have started the enterprise themselves little think."

Alas—alas! how has this prediction been verified!

But we cannot enter upon a subject so agonizing as the loss of the President—the wounds are not yet cicatrized, but bleed afresh at the tenderest touch. The wail of the widow and the orphan—of the affianced bride and the childless father, is yet sounding in our ears; and memory rekindles emotions which are only to be assuaged by time the comforter. The repetition of such calamities is now, heaven be praised! unlikely. And oh! what *can* be the reflections of those, if any such there be, by whom the one dire calamity has been directly or indirectly superinduced? Can any thing be more reprehensible than that reckless precipitation which not merely sets at nought all consideration of failure and ruin, but tampers without compunction with the lives of the best and noblest of the land?

Having in the preceding pages adverted on several occasions to what Dr. Lardner did *not* say, we shall now attempt to show the nature of the opinions respecting the Atlantic enterprise he *really did* entertain. We are fortunately in possession of an authentic and well known record upon this subject, in the shape of an article written by Dr. Lardner for the Edinburgh Review, and which will be found in the 131st number (1837), of that publication. From this article we shall make considerable extracts.

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[*] Thoughts on Steam Locomotion. Weale, 1840.

"The imposing mechanical phenomena so rapidly and unexpectedly developed by the invention and improvement of the locomotive steam engine, and its application to railways have for several years so engrossed public attention that other means of facilitating the operations of commerce, and expediting the social intercourse of distant masses of people less fascinating perhaps, but not less important, have been comparatively overlooked. The subject of water transport by steam has from this cause received less than its due share of attention. A re-action however appears to have been recently produced, and we have now a swarm of projectors much more largely supplied with zeal than knowledge, who not content with advancing in the march of improvement with that calm deliberation and salutary caution so necessary to insure a permanently profitable issue for any great undertaking, would rush to their ends without ever informing themselves of the means at their disposal, and proceed *per saltum* from a channel trip to the circumnavigation of the globe.

Within the last year, considerable public attention has been directed to the question of the practicability and advantage of establishing a line of steam communication between Great Britain and the United States, and various projects have been started and companies formed for the construction of vessels for that purpose, several of which are already in a state of forwardness. At a meeting of the British Scientific Association held at Bristol last September, one of the topics which engrossed a large share of interest, was the question of the practicability of a steam voyage across the Atlantic, raised in the mechanical section. The statement laid before that section by Dr. Lardner obtained such publicity at the time through the press, that it would be superfluous to recapitulate its arguments. The conclusions however at which he arrived were briefly these :—That in the present state of the steam engine as applied to nautical purposes he regarded a permanent and profitable communication between Great Britain and New York by steam vessels, making the voyage IN ONE TRIP, as in a high degree improbable : that since the length of the voyage exceeds the present limits of steam power, it would be desirable to resolve it into the shortest practicable stages ; and that therefore the most eligible point of departure would be the most western shores of the British Isles, and the first point of arrival the most eastern available parts of the western continent; and that under such circumstances the length of the trip, though it would come fully up to the present limit of this application of steam power, would not exceed it, and that we might reasonably look for such a degree of improvement in the efficiency of marine engines, as would render such an enterprise permanent and profitable."

Dr. Lardner then goes on to state that it had been objected to his conclusions, that the data from whence they were derived had been obtained from the performance of steam vessels antecedently to 1834, whereas since that period considerable improvement was alleged to have been effected in steam machinery, which by diminishing the consumption of fuel was considered to have improved the prospects of Atlantic steam voyaging. Of all the vessels then existing the Medea was universally allowed to be the one which was capable of being impelled over the greatest distance with a given quantity of coals per horse power; she was therefore the most favourable actual standard by which prospects of the Atlantic enterprise could be measured, and was adopted as the basis of the present inquiry. Dr. Lardner then proceeds to show that the same conclusion respecting the Atlantic enterprise which he had already deduced from the performances of vessels antecedently to 1834, was also deducible from the performances of the Medea, and of other vessels between 1834 and 1837.

The misconception which has existed respecting Dr. Lardner's opinions upon this question, and which nothing short of misrepresentation prepense was sufficient to have created, renders it proper here to repeat that the limits which exist to the achievements of steam power are not imposed by any abstract impracticability of performing steam voyages of any length whatever. but by the impracticability of rendering those voyages sufficiently profitable to confer permanency upon enterprises in steam navigation. The doctrine attributed to Dr. Lardner that a steam vessel (or any vessel), if only sea worthy, was incapable of proceeding from Great Britain to the coast of North America, is so palpably absurd that it scarcely deserves to be noticed.

Dr. Lardner has however offered the following observations upon the subject, which we extract from the Monthly Chronicle, Vol. II., 1838.

"A vessel having as her cargo a couple of steam engines and some hundred tons of coal, would be *celeris paribus* as capable of crossing the Atlantic as a vessel transporting the same weight of any other cargo. A steam vessel it is true would labour under some comparative disadvantage, owing to the obstruction presented by her paddle wheels, and the paddle boxes which cover them: still, however, it would be preposterous to suppose that these impediments would render impracticable her passage to New York. If therefore such a vessel merely transported her machinery and fuel without working the one or consuming the other, she would still make the passage. That a steam ship may be a tolerably good sailing vessel is proved by the fact that the steam frigate Medea, one of the most efficient steamers in the service of the Admiralty, accompanied the fleet many thousand miles propelled by sails, and without working her engines at all. If then a steam ship viewed merely as a sailing vessel, freighted with engines and coals, can traverse the Atlantic with certainty, how absurd is it to suppose that the abstract practicability of such a ship making the voyage to New York with the aid of her machinery and fuel can for a moment be doubted!

"In fact no doubt has been entertained or expressed as to the practicability of establishing a communication between these countries and New York, by a line of steam vessels. But a difference of opinion has been entertained as to what mode of accomplishing the object may best ensure certainty, safety, regularity and profit, without which last element it is presumed the other objects could hardly be secured."

Returning from this digression to the Edinburgh Review, we find Dr. Lardner explaining the inconveniences to which extended steam voyages are subject, arising from the incrustation of salt in the boilers, the deposition of soot in the flues, and other matters of that nature, to which we consider it unnecessary more particularly to refer. He then proceeds—

"The several circumstances to which we have adverted, constitute difficulties, having the general tendency to abridge the practicable extent of an uninterrupted steam voyage. There remains a still more serious impediment to the extension of steam navigation inherent in the very substance from which the engine at present derives its mechanical power—an impediment which places a definite and assignable limit, beyond which it is mechanically impossible to extend the voyage of a steamer (of ordinary construction). To form an estimate therefore of the major limit of the extent of a continuous steam voyage, it will be necessary that we should examine, 1st. The proportion in which the capacity of the vessel may be distributed between the machinery, the fuel, and the objects of commercial transport; and 2ndly. The rate at which the fuel will be consumed in propelling the vessel over a given distance, regard being had to her tonnage and power.

"Assuming that a certain extent of the capacity of the vessel is appropriated to the mechanical means of propelling her, that portion will obviously be shared between the machinery and the fuel, by which that machinery is moved.

"The proportion in which this space should be distributed between the machinery and the fuel will vary according to the length of the voyage. As the fuel may be replaced at the end of each trip, and as it is generally advantageous to give the vessel as powerful machinery as the extent of her capacity will admit, it is obviously expedient to reserve as limited a space as possible for the fuel, and to give a proportionably increased extent of room to the machinery. In the shortest class of voyages therefore a smaller supply of fuel being sufficient, a larger space must be appropriated to the machinery, and in proportion as the length of the voyage is increased, the quantity of space necessary for the fuel will be augmented, and that allotted to the machinery diminished. To this there must be an evident limit; inasmuch as the space for the machinery must be sufficiently extensive to contain engines of the power necessary to encounter the difficulties of the navigation, and to insure an average rate of progress greater than that of sailing vessels."

This limit, be it observed, is one of expediency—not of abstract practicability. To state the matter in other words—a certain determinate proportion must be observed between the power and tonnage, else the vessel will be incapable of carrying coals enough for the voyage, or her speed will be so defective as to give her no prominent advantage over sailing vessels. And the adherence to this proportion involves the necessity of employing vessels of such magnitude as to be of too expensive maintenance for the profits of an ordinary trade. For as in a symmetrical vessel the resistance increases nearly as the square of the increment of one dimension, and the capacity nearly as the cube of the increment of the same dimension, so it is in a certain point only in the divergence of those series where a result is obtainable, answerable to the conditions indispensable to Atlantic steamers. And that point is so high up in the series, the resistance and capacity are both so great as to indicate the necessity of employing those leviathan vessels, whose voracious appetite is unappeased by the expenditure of all the proceeds of any merely commercial enterprise.

"To arrive at a practical conclusion as to the major limit of a probable steam voyage under average circumstances of wind and water, it will be obviously necessary that we should obtain some probable approximative estimate of the impulsive virtue of a given quantity of coals of average quality. The consumption of coals, other circumstances being the same, will be proportional to the power of the engine, and it will therefore be sufficient to determine what is the average rate of hourly consumption for each horse power in the machinery."

A table of the performances of a number of different vessels between 1834 and the date of the Bristol meeting, but which we consider it unnecessary to insert here, shows that the locomotive duty of the Medea was greater than that of any of the rest; the locomotive duty as defined by Dr. Lardner being "the distance over which a ton of coals per horse power is capable of propelling a vessel."

Dr. Lardner proceeds—"To enable us to establish an analogy between the performances of these vessels and the circumstances under which a steamer would be placed in navigating the Atlantic, it will be necessary to explain some physical phenomena attending that ocean.

"The general atmospheric currents which prevail in directions near and parallel to the equator, from east to west, called the *trade winds*, would have a tendency to produce a derangement in the atmospheric equilibrium, if not redressed by a contrary effect elsewhere. It is known that those remarkable winds are produced by the influence of the solar heat upon the atmospheric belt included between the tropics, combined with the diurnal motion of the earth from west to east. The heated air pressed upwards by its buoyancy, is replaced by currents from either hemisphere, which carrying with them a less diurnal motion than that proper to the tropics, a relative atmospherical motion is produced in a direction contrary to that of the earth's rotation. Hence a nearly permanent wind is produced on each side of the line from east to west. As these currents approach the line, they gradually acquire the motion of the surface, which combined with their mutually counteracting effect, produces those calms which prevail about the line, and which are only interrupted by the hurricanes, whirlwinds and other violent atmospheric commotions which are produced where the contrary tropical currents conflict before their force is sufficiently moderated.

"The stagnant atmosphere thus collected at the line, ascending by the effect of solar heat, returns from the upper regions towards the poles, and coming upon the surface in either hemisphere brings with it the diurnal motion of the equator, which being greater than that of the higher latitudes, prevailing winds are produced from the west. The agency of these causes is manifested in the westerly winds which prevail almost uniformly throughout the Atlantic between the shores of Europe and those of North America. There are other physical causes which mingle their effects with those to which we have just adverted. The extensive regions of North America covered with immense fresh water lakes and primeval forests, supply a current of cold air rushing into the warmer strata over the track of ocean between the Azores and the American coast. This current from the north-west consequently modifies the re-action of the trades just explained; the result is wind blowing generally in the westerly direction, but varying between north-west and south-west, and sweeping across the face of the Atlantic throughout nearly the whole year.

"Atmospheric difficulties are not the only ones which the navigator has to encounter who crosses this extensive tract of water. The well known Gulf stream is a great ocean current issuing from the channel which separates Florida from the Bahama banks, taking first a direction a little to the east of north, and becoming more and more westerly, until it approaches within a short distance of the tail of the great bank of Newfoundland, where it sets in due east towards the Azores. The width of this current at first one degree, gradually increases until it exceeds two degrees. Independently of the difficulty presented by the stream itself, the zone of the ocean marked out by it is characterised by weather so extremely unfavourable to navigation, that it is cautiously avoided by all outward bound vessels. They invariably either take a course so far north as to be clear of its influence until they approach the western shores, where by taking a southerly direction they convert the westerly winds into favourable gales; or on the other hand proceed first southward till they get beyond the lower limits of the Gulf stream, and taking advantage of the trades, make the western coast. This latter, however, is a route never adopted by the best class of New York packets, except they are reduced to a disabled state.

"The westerly winds which we have described as prevalent across the Atlantic, are accompanied by a heavy sea, which is subject to scarcely any subsidence or intermission. In land locked seas such as the Mediterranean and the channels which intersect contiguous islands, the effect of the wind in raising the waters is rapid and produces a short and chopping sea highly unfavourable to steamers; but these effects speedily subside, and in the Mediterranean especially they produce but a slight influence upon the average rate of vessels, when that average is computed from long continued performances. On the other hand the long swell of the Atlantic is not so unfavourable during its operation, but its effects are incessantly, and considerably more disadvantage to a steamer will be produced by its continuance, than any which the occasional roughness of the more contracted seas to which we have referred could give rise to."

It is right to observe that a "short chopping sea" is a relative term, having reference not merely to the nature of the waves, but the size of the vessel. That which is a long swell to a row boat is a short unfavonrable sea to a small vessel, and that which is a long swell to a small steamer, or even to a steamer of 500 or 600 tons, may be a short chopping sea to one of 2000 tons. The swell of the Atlantic therefore may be of as prejudicial a quality to the large Atlantic steamers as that of the Mediterranean, and of the channels is to the smaller vessels navigating those waters.

Another formidable objection to Atlantic steam voyaging arises from the overwhelming force of the Atlantic storms. The shock of masses of water roused into violent commotion by the accumulated momentum of every wave in the whole three thousand miles of foaming waters is nearly irresistible, and is productive of the most injurious effects to vessels of large dimensions impelled by immense steam power. We ourselves happened to see the Liverpool in dock after an exposure to one of these Atlantic storms, and she was really little better than a wreck. The straining she had undergone was inconceivable: the seams of the deck had opened greatly, a great part of the copper had been detached from the bottom of the vessel in consequence of the irregular movement of the planking to which it had been nailed, and the oakum hung out of many of the seams in the exterior of the vessel, even below the water line, from which the great straining had displaced it. The "British Queen," it is well known has been similarly injured upon more than one occasion, and the frames of the engines of the Great Western have been all broken by the working of the ship. The wear and tear arising from this source is infinitely more to a long large steamer than to a compact well built ship; and the danger resulting from the same cause is not inconsiderable. The icebergs which are not unfrequent in the latitude of Newfoundland are another source of danger, and the dense fogs met with in the same region are highly unfavourable to steam navigation; whilst the consequences of fire, a by no means uncommon visitation in steam vessels, in the midst of the Atlantic, are appalling to contemplate. Several of these obstacles are manifestly irremoveable, and are therefore only capable of being regarded as neutralizing to a certain extent, the benefit, if any, of the scheme. But others, and those the most formidable, are susceptible of diminution by the division of the voyage into suitable stages.

"Seeing then the unfavourable aspect under which the project of establishing an uninterrupted line of steam navigation between Great Britain and New York presents itself, let us consider whether by resolving the voyage into the shortest possible stages, the enterprise may be brought under more promising conditions. For this purpose it is obvious that the most western coast of the British Isles should be taken as a point of final departure. The west coast of Ireland would therefore be naturally selected, fringed as it is by numerous spacious and well sheltered harbours. St. John's, Newfoundland, is the most western port, but this harbour is attended with so many nautical difficulties that it could scarcely be regarded as accessible with that certainty which such a line of communication would require—Newfoundland presents an iron-bound coast; and even Nova Scotia should be avoided were it possible to extend the passage: but the distance from the west coast of Ireland to Halifax comes up to the extreme limit of a (profitably) practicable steam passage. *We greatly fear that any attempt to supersede the necessity of making Halifax a stage must prove* ABORTIVE."

In conclusion, Dr. Lardner observes, "Let us however not be misunderstood. That the passage from Liverpool to New York cannot on any occasion be made in one run by a steam ship, we do not maintain." But he declares his conviction that as a practical, permanent, profitable thing, Atlantic steam voyaging will not and cannot be in the present state of the art successful. And this conclusion he is content to avow, notwithstanding its unpopularity. "In confessing then as we do, that after the most careful and anxious inquiry respecting this interesting question, our fears of the result of such an enterprise greatly preponderate over our hopes, we are sensible of expressing an unpopular opinion. It is the natural and fortunate tendency of the human mind to anticipate success, and we ourselves shared this feeling when we commenced the present investigation, we were wholly unaware to what point results since ascertained would lead us."

We shall offer no further remarks respecting Dr. Lardner's statements, which are well able to speak for themselves, but shall at once proceed to the second part of our subject, viz., the determination of the present condition of the enterprises for maintaining a steam communication between Great Britain and New York. This may perhaps best be shown by an enumeration of the several vessels which have been employed upon that line, and the mode of their respective disposition.

Sirius	withdrawn.	
Royal William	withdrawn.	
Great Liverpool	transferred	Now maintaining steam communication with India, via the Red Sea.
United States (now Oriental)	transferred	
British Queen	sold.	
President	lost.	
Great Western	for sale.	said to be.
Great Iron steamer, (unfinished)	stopped.	

The HALIFAX line which carries out Dr. Lardner's recommendations to a certain extent alone thrives; yet it has been questioned if even *it* could continue to keep the field without the aid it derives from the conveyance of the mails, unless it were to make the western coast of Ireland, the point of final departure. The question might be worth considering by the proprietors of the Halifax packets as well as by the West India Mail Packet company, whether it would not be greatly to their advantage if all of their vessels were to make the western coast of Ireland, their point of arrival and departure. But should the managers of those companies think differently, should the shareholders resolve in spite of common sense and Dr. Lardner, to throw thousands upon thousands of pounds sterling into the gulf of DIRECT communication, they are quite welcome for aught we care to continue to indulge so reasonable a predilection.

There is one circumstance connected with the preceding table of the manner in which the vessels are employed in the Atlantic enterprise, which affords an example so striking of the coincidence between the deductions of philosophy and the results of experience, that although it has no immediate reference to the present subject, we cannot permit this opportunity to pass without saying a word respecting it. Dr. Lardner it is well known did not confine his inquiries to Atlantic steam voyaging, he also discussed the merits of steam communication with India, via the Red Sea, and it may be satisfactory collaterally to ascertain what his opinions were respecting that line of intercommunication. We shall find those opinions stated in his letter to Lord Melbourne, published in 1837, from which we extract the following passage: "It has been contended that the question should not be regarded as one to be determined merely upon a calculation of profit, that on the contrary, it is one with which great political and social interests are interwoven so closely that it ought to be adopted even though its entire cost should have to be defrayed by the nation. This principle has been implicitly admitted in the resolutions of the Select Committee of 1834, and it has been explicitly avowed by the late Governor General, by several honourable members of the legislation, and of your lordship's administration. But it is a principle which I think it unnecessary to discuss in the present case, because *there is no proposition, however self evident, which carries to my mind a more clear conviction than I have, that this measure, if efficiently carried into operation, will more than return its own expences.*" Here is an opinion diametrically opposite to that delivered respecting Atlantic voyaging. Let us inquire how far this conclusion is borne out by experience.

The "Great Liverpool" having in a single season earned a LOSS to her proprietors of six thousands sterling upon the New York line it was determined to withdraw her; and with another new vessel built for Atlantic voyaging, now the Oriental, to open a communication with India, viâ the Red Sea. The proprietors of the British Queen, who we have been informed, have sustained a loss of about *sixty thousand pounds* in Atlantic steam transit, became competitors with the Great Liverpool and Oriental for the Alexandrian line, plainly showing that both of those companies after a vast expenditure of money, had arrived at the very conclusion Dr. Lardner held three or four years before. Has it never occurred to the proprietors of those vessels that they might have saved about 100,000*l.*, as well as vast responsibility, anxiety, risk and discredit, if at the commencement of the Atlantic discussions they had prevented their passions from exercising their favourite calling, that of running away with their reason?

A recent meeting of the proprietary of the Peninsular and Oriental Steam Navigation Company enables us to state that oriental steam voyaging has been highly successful, and this result has been attained with the same vessels and by the same management that were incapable of realizing any thing but loss on the New York line. It is plain from this result that the Atlantic enterprise did not fail from mismanagement, even were we not assured, as we are, that Mr. Carleton and mismanagement are altogether incompatible. Can a coincidence such as this between prediction and reality be merely fortuitous?

Has Atlantic steam navigation been successful? Has the establishment of the several lines of steam communication between Great Britain and New York been productive of a permanently profitable issue? We leave the verdict to our readers, our part being merely to furnish such remarks and data as may conduce to the attainment of a just conclusion. Had we set out with a different resolution, we might perhaps have given it as our opinion that the Atlantic scheme had proved itself a signal failure—that Dr. Lardner's views had been confirmed with singular exactness—that

Earth has its bubbles as the water hath,
And this is of them.

But we originally said, as we now repeat, that we do not mean to divulge our own opinion.

One consummation there is devoutly to be wished, namely, that Dr. Lardner will soon return to this country, to resume the wand which, like Prosperos, none but its master can wield. We can see no other antidote against that worst of Egyptian plagues, the swarms of vermin with which the track of practical philosophy is now overrun. We are death sick of the reign of minute philosophers. If the choice rested with us, we would say, give us back our wolves again—restore the dominion of barbarism—curse us with any thing except the cant of philosophical imposture—the disgusting egotism of idiotic mountebanks. Dr. Lardner's return to England would be the death warrant of all such quacks, which is of itself a sufficient reason to inspire the ardent desire that his return will not be much longer delayed.

Z.

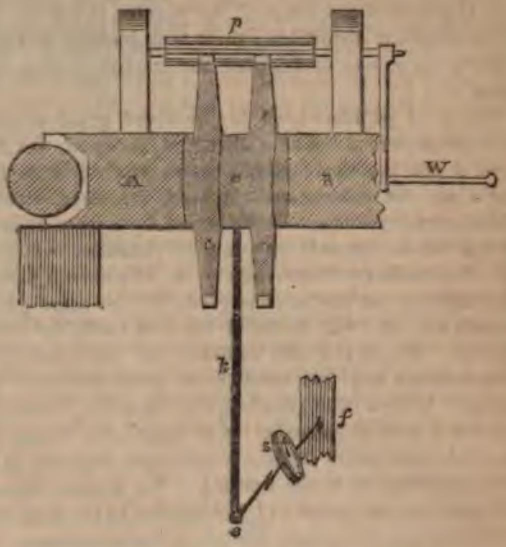
REMARKS ON THE TRACTIVE POWER OF PADDLE WHEELS.

In the theory of the nautical steam-engine there is no point that deserves more attention than the means employed to obtain propelling reaction from the water. The disadvantages which the various plans at present in use labour under, have been very ably pointed out by the different writers in the appendix to the new edition of Tredgold's treatise, and the mortifying result is that nearly half the effective power of the engine is lost by the motion necessarily given to the water by the paddles and their oblique action. Besides the lost power from these causes, there are other disadvantages which the nautical steam engine labours under. A change in the velocity of the vessel, as well as a change in the immersion of the paddles, alters the relation between the power of the engine and the propelling effect. Under the most favourable circumstances, if the power of the steam generated be reckoned 100, the efficient power acting on the paddle wheel is about 60, and the efficient propelling power only from 35 to 40; the power generated thus requires to be nearly three times the work done. It is evident that under given circumstances with a given engine, a certain relation subsists between the extent of effective paddle surface and diameter of the wheel, to obtain a maximum speed, or in other words a maximum propelling duty. It is probable that the experience of steam ship-builders enables them to fix upon very nearly the best proportions for an average immersion, but is there any method of proving that the best proportions have been exactly obtained. There are not wanting very notorious instances to the contrary. It may be said that exactness in this is not of much importance, as the proportions that answer best in a calm will not do for rough weather, and *vice versâ*. Suppose the best proportions have been obtained for calm weather, and an average immersion the same propelling effect will not be maintained if the vessel,

1st. Has greater immersion.
2nd. Has less immersion.
3rd. Is employed towing when not constructed for such work.
4th. Has to make way against a foul wind or head sea.
5th. Has a fair wind, and employs both steam and canvass.

This arises both from a greater absolute loss of power in application, and likewise from the engine being obliged to work with reduced duty. Since, then, the engine is liable to so many adverse circumstances, it would be a great desideratum if the proportion that exists between the effective duty on the paddle-wheels and their propelling duty could at all times be known. The advantage or disadvantage of any change in the paddles would then be pointed out in a way that could not be misunderstood. The first or effective duty of the paddle-wheels may be considered as proportional to the number of revolutions per minute with the same steam pressure; the propelling duty is measured by the number of revolutions conjoined with the horizontal forward strain of the paddle-shaft on its bearings, or the direct tractive force exerted by the engine on the vessel.

The difficulty is to measure this. Is it practicable to do so by measuring the intensity of the friction of two surfaces submitted to the horizontal pressure? The following has occurred to the writer as one mode of doing this. How far it is practicable or likely to be efficient, he must leave practical men to judge.



The figure is drawn to show simply the mode of action. The beam A presses on B with a varying force. Two wheels *c c*, worked by a pinion *p* and winch *w*, are embedded between the beams on one side, and the central friction piece *d* on the other: the contiguous surfaces being ground perfectly smooth. To the centre friction piece *d*, an arm *k* is attached the extremity of which *e* is connected with a fixture *f* by the intervention of *s*, a spring weighing machine or other dynamometer. By turning the winch the wheels *c c* are made to revolve slowly, these, by the friction of their inner surfaces against *d* tend to draw it along with them with a force which, according to the experiments of Coulomb, Rennie, and others, is nearly proportional to the pressure of A on B, and quite independent of the rate at which the wheels *c c* are made to turn. This force by means of the arm *k* will be shown by *s*. To set off the scale upon *s*, it will be necessary to apply known forces to A. This is the only adjustment required, and may be made on the apparatus before being applied to the engine.

Other arrangements of the apparatus will readily occur. In applying it to four bearings, one winch and spring might be made to answer, so as to give the measure of the tractive power at one observation. As an instrument for measuring pressure, this might perhaps be employed for various other purposes. I fear, however, that it is too simple to have escaped the notice of practical men, and that it has been tried and rejected. If not, the information it is intended to convey has not been thought of such importance as to call attention to any thing of the kind. But while so many conflicting opinions are entertained on the subject of paddle wheels, it appears to be the only thing that will properly bring out the true results of experiments, and distinguish what is due to the build of the ship and what to the paddle-wheels. Those paddle-wheels that evolve the greatest tractive power with the full expenditure of steam are the best for the given immersion, and this would be indicated by the speed of the vessel. But if it were required to find what immersion allowed the engine to exert the maximum propelling duty, the speed of the vessel would obviously not be a proper index, unless the relation between the immersion and tractive power were known. Again, if it were desirable to compare the useful qualities of a paddle-wheel at the same immersion but different velocities, a knowledge of the tractive power is essential, and would be sufficient. This would also be the case in judging of the effects of a rough sea. If we might suppose steamers generally to have such traction gauges, and a careful register of its indications kept during all weather, and at every variety of immersion, each voyage would have all the character of exact experiments, and the results would bear upon the build of the ship as well as the efficiency of the paddles in the given circumstances. The effects of fair or foul weather would also be made manifest. If the best kept steam logs are examined with the view of obtaining information in regard to the qualities of the paddles, it will be found impossible to make any deductions; there is an absolute darkness merely from there being no way of knowing the tractive power exerted by the engine.

The theory of paddle-wheels has received great attention from several of the writers in the new edition of Tredgold, but it may be questioned if the practical deductions are equivalent to the labour bestowed upon the calculations. Indeed, the circumstances which affect them are too various to be embraced by mathematical formulæ. Besides, the whole depends on a law of resistance which is hypothetical. The masterly disquisition by Mr. Woolhouse seems to exhaust the subject; but the formulæ given by the same gentleman in the foot note at p. 301 will be found the most useful for the purpose of instruction. These, if a little modified and amalgamated with the concluding formulæ at p. 194, would be of great service to the young naval officer. With a little knowledge of algebraic notation, so as to work out the numerical values of each expression, taking numerous examples, he would obtain a facile acquaintance with the peculiar and unique relations that affect the working of the nautical steam-engine. Thus he would become aware of the difference in the proportions that ought to distinguish the paddle-wheels of a towing vessel, the disadvantages that a common steamer labours under when employed in towing, or a towing vessel when steaming by itself, the evils of too deep or too light immersion, &c. A small publication adapted to such views appears to be a desideratum at present, and would be calculated to benefit a numerous class who ought to have a thorough knowledge of the subject. The method of working out numerical examples from the formulæ would be the means of communicating such knowledge without the necessity of mathematical attainments.

It is singular that no notice is taken of the theory of paddle-wheels in the treatises on the nautical steam-engine by Lieut. Otway and Robinson, although in point of importance it deserves nearly as much space as the engine itself. Indeed, it is a subject that deserves the attention of the naval officer more than any other, as a difference in the weather, immersion, &c. so notably affect the amount of work performed by the engine. To be fully acquainted with the power he has at command, he must know, from studying the theory of paddle-wheels, and their connexion with the velocity of the ship and of the engine, how much that power is liable to be diminished or increased by circumstances, that are wholly independent of the condition of the engine itself. A single example will show the importance of this; take that of an 800 tons war steamer which makes 10 knots in a calm, the engines working at full power. The velocity per second is 17 feet; the circumferential velocity of the centre of the paddle boards is 23 ft. leaving 6 feet for the back velocity of the paddle-boards. Now with a head wind and sea sufficient to stop the ship way so that it is just able to maintain its position without drifting to leeward. The greatest power that the engine is capable of exerting, would be reduced to $\frac{6}{25}$ or ½, what it was in a calm. Thus ¾ of the steam raised in the boiler becomes useless. The engine becomes paralysed from the connection of the parts being adapted to only one velocity and immersion. If it were possible to construct it otherwise, so that full duty could be maintained in all circumstances, the steamer could make nearly eight knots against such a gale.

To look forward and answer the question—What is required to render the application of the steam engine to navigation perfect? Two great sources of disadvantage present themselves:

1st. The motion given to the water to gain propelling reaction.

2nd. The motion of the piston is not uniform under varying circumstances of immersion and speed of the vessel, neither is the momentum of propulsion communicated by the engine equal in equal times.

With regard to the first it may be remarked, that if the reaction is supposed to take place merely from projectile force given to the water, the quantity put in motion to generate the same propelling force in equal times will be directly as the area of the paddle boards. But the loss from the back action of the paddles will be inversely as the same. If the practical advantage of having small paddle-boards is merely to present less surface to the shocks of a boisterous sea, their surface may be reduced in proportion to the square of the augmented velocity. Thus, taking the previous example, the area of the paddle boards that require 6 feet back velocity, and communicate a propelling duty of 17, may be reduced one half without reducing the duty more than 2½ or to 14½, and the velocity of the ship from 10 to 9½. On the other hand, by doubling the area the propelling duty would only be augmented to 18¾, and the velocity to 10½.

The disadvantage of a considerable loss from receding in the water will always exist so long as the propelling reaction is derived from it in a *continuous* manner.

If the same extent of surface is made to move through the water with double the velocity, it will gain the same propelling reaction from the water in one fourth the time, and to do so will have to move over one half the space; so that if it were possible to apply the power of the engine in this manner, the propelling duty would rise from 17 to 20. But to effect this, it would be necessary to arrange the machinery so as to expend on the water, in a quarter of a second, the power generated by the engine in one second; and on the other hand to distribute the force of reaction derived from the water in a quarter of a second, so as to serve as a propelling power during one second. The action of the oars in rowing is a familiar instance of this; the consequence is a considerable fluctuation in the velocity which on a large scale would be very disagreeable if not otherwise objectionable.

To obviate the second source of disadvantage it would be necessary to arrange the machinery so as to vary the absolute velocity of the paddle floats, according to circumstances, while retaining the same back velocity at all times. To effect this it would be necessary to arrange the machinery so as to vary the absolute velocity of the paddle floats, while, retaining the same back velocity, to obtain this it would be necessary to disconnect the wheel from the engine, and by a shifting leverage to bring the lowermost paddles only under its full action, while the others are allowed to revolve passively by catching the water. It is quite possible to make an arrangement to effect all here that the theory demands, but how far such would be concomitant with practical efficiency, is a much more difficult question.

It may be remarked that the screw propellers are as much influenced by these disadvantages as the common paddles, but they are not so much affected by oblique action or by waves, besides not being so much exposed to cannon shot.

J. W.

Bombay, Sept. 21, 1841.

THE NELSON COLUMN.

Sir—On approaching this column from Whitehall, we become sensible of what appears to be a great mistake in the *position* of it, for while the *statue* of Charles the First seems to rise in the centre of the street, and in a line with the centre of the portico of the National Gallery, the *column* is placed quite to the *left* of that line, so as to appear engaged with the houses near Drummond's Bank, and to rise not in the centre of the street or of the portico, but quite to the left of both, thereby producing a most awkward effect. Upon further examination I found this was owing to the architect having thought it necessary to place it in a line perpendicular to the centre of the plane of the portico, whereas had he erected it in a line from the centre of the portico through the statue, this line though not *quite* perpendicular to the plane of the portico, would have deviated from it in so *very slight a degree*, as not to be perceptible to the nicest eye, and would have obviated completely the very glaringly awkward effect of its present position, which, whether viewed as you turn up Whitehall or from the centre of the portico, is equally offensive to the eye, which would have been quite insensible to the very trifling deviation from the perpendicular in the line above mentioned.

Aestheticus ——.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXXIII.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. A "little bird" has reported to me that there have been sundry and several complaints, which complaints I am willing to accept as compliments. Never did I for a single moment imagine that my Note Book would be palatable to every body, being aware that it must, on the contrary, be unpalatable to a good many bodies, who, nevertheless, it seems, cannot abstain from reading it, notwithstanding that it is entirely optional on their part to do so or not. If those particular articles are not at all to their taste, why, in the name of common sense, do they not pass them over? They are no more compelled to read every column of every number of the Journal, than to wade every morning through the whole of the Times newspaper, advertisements and all.

They do not relish Candidus; so be it—I will not quarrel with them on that account; nevertheless, I merely say that at all events their dislike appears to be no more than a mere disliking, for which they either are unable or do not care to assign adequate cause, else wherefore should they be so forbearing as not to expose what they consider my errors and mischievous or unsound opinions. If my Note Book contains a good deal of "nonsensical stuff," its nonsense must at any rate be of a very attractive kind, since it compels them to read whether they will or no. Therefore, if it finds readers, both among those who relish, and those who disrelish it, I have no particular reason to be ashamed of it.

I suspect there is another and more powerful motive than mere dislike which makes my Anti-Candidus express themselves with a soreness and sourness. It is very true they themselves can skip over the offensive Fasciculi, but they cannot compel others to do so. Aye, there's the rub! They are frightened, lest other people should read—and perhaps have their eyes opened, by some of my remarks, to prejudices and abuses which they would have remain untouched, and to abuses they would rather screen than expose. No doubt there are some who, were it in their power, would suppress architectural criticism, and architectural journals likewise, altogether; and that for very sufficient and prudential reasons, as far as themselves are concerned. Well are they aware that the more the public are kept in ignorance of architecture, and the less any topics belonging to it are brought under discussion, the better for them. No doubt there are several worthy gentlemen who, if they durst, would protest against the exposures which have from time to time been made relative to mal-practices in competition; others, again, who think that it is high time for this Journal itself to be brought to a close. Such persons may not exactly be simpletons themselves—on the contrary, exceedingly wise in their generation; but assuredly they must take editors to be complete simpletons and noodles, if they suppose the latter will alter their places and arrangements according to the fancy of every body or any body who chooses to express a dislike to any part of them, Surely my Note Book is not so contagious as to infect with its virulence the whole of every number of the "Civil Engineer;" should it, however, really be so—in the opinion of certain people at least; such persons had better decline taking in the work. Awful would be the consequences—positively fatal to the publication; for our editor might then say, as H—— the celebrated bootmaker is reported to have done, when a blustering consequential gentleman once threatened to deal with him no longer, "John, do you hear that? Tell them to close the shop windows directly. It is all up with us now—we are positively undone, for here is Mr. ——— going to withdraw his custom from us! But John, first of all open the door for Mr. ———, and wish him a very good morning."

II. Among the odd "*They says*" of the day, it has been rumoured that the magnificent structure now building in Threadneedle Street is destined for nothing less than the reception of the Soanean Museum. That such must certainly be the case, is argued because no one can tell or possibly divine, what it can be intended for at all, if not for such purpose. Another cogent argument is derived from Sir John's well known attachment to the old lady of Threadneedle Street—her, I mean, who keeps the money-shop—and although these may seem very insufficient reasons, exceedingly vague and chimerical ones, far graver hypotheses have been hatched into systems all-compact, out of hints and surmises equally visionary and fantastical. It will be objected that the Soanean Museum must not on any account be removed from the house it now occupies—but then there is not the slightest necessity that it should be, since house and all may be removed from Lincoln's Inn Fields to Threadneedle Street—a mere step of way compared with the distance a house once travelled to Loretto—and be commodiously enough placed in one of the spacious halls within the new structure, without undergoing any Procrustean operation. Though small as a house, it will cut a very respectable figure stuck up in a room as a model. It may, indeed, further be objected—however, I cannot stand to knock down objections, like ninepins, as fast as people choose to set them up, therefore must be allowed to cut them short by calling upon any body who thinks himself capable to start some more *ingenious* idea than my own as to the proposed destination of the building in question.

III.—Travellers have undoubtedly the privilege of romancing—that is, of lying, including a little blundering also; but when Mrs. Abigail Adams says that Canterbury contains "*a number of old cathedrals*," she does avail herself of the traveller's privilege rather too freely, and indiscreetly also. Perhaps the good lady "saw double" at the time, and seeing two cathedrals, multiplied them into a "number." Another no less extraordinary blunder occurs in a very recent German work on St. Petersburg, in which the writer has confounded the Kazan *Sobor* or Cathedral with the new St. Isaac's church, and has made the whole account a continued blunder, for he has gone describing and criticising the former building, mistaking it all the while for the latter; which is the more unaccountable, because the last, which is hardly yet terminated, happens to be just now the great architectural lion of the Northern capital. It is as if any one should mistake St. Paul's for the new Houses of Parliament, and describing the latter as having been erected by Sir C. Wren, speak of their noble dome. In one of the volumes of Lardner's Cyclopædia, Covent Garden Theatre is said to be a specimen of Grecian Ionic architecture, while the Post Office is similarly metamorphosed into one of Grecian Doric—which proves that if Doctor Diogenes Larnedman, as Fraser calls him, was not a downright humbug himself, that he certainly employed literary ignoramuses and humbugs to manufacture some of his books.

IV. "Love at first sight" is not always to be relied upon—at least not in architecture; there are many productions, whether buildings or designs, which captivate the eye at first view, yet sadly disappoint us when we come to examine them, or after we return to them. One almost infallible test of merit in art, that after the interest of curiosity has subsided, a work will not only continue to captivate, but that beauties, at first scarcely noticed, make them felt more and more. It would be well were every architect to apply such test to his own designs and studies, to examine them scrupulously, after laying them aside for awhile, for the purpose both of ascertaining whether they satisfy him in his own mind as well as they did at first, and of considering how they might be further improved. Invention and fertility of imagination may do much, they indeed furnish the ideas upon which to work, but the great secret of perfection lies principally in the careful study of the whole, and no less carefully finishing up of every part. The "slap-bang" school are above all such dilatoriness and trouble, they do not stand upon trifles; with them every thing is hit or miss, they never blot, they never revise; it is always "first come, first served" with them; they consider it loss of time to wait for a second idea. They are worse than bears, for they do not even care to lick their own offspring into shape.

V. The character of the "celebrated Mr. Compo," in the tale entitled "St. Antholin's or Old and New Churches," is by no means an over-drawn caricature. The cheap-church mania has afforded employment of late years to a good many Mr. Compos, manufacturers of Brummagem Gothic, or Brummagem Grecian—tasteless noodles in themselves, but who find still greater noodles who patronise them. The Compos may be said to be what is usually termed "a fine family"; they spring up like mushrooms, although very few of tnem ever *vegetate*. There is a church now going on somewhere in town, which, it is to be feared, will turn out a very Mr. Compo-ish affair, a most dainty specimen of Brummagem Gothic. The necessity for strict economy may be sufficient excuse for plainness, but none whatever for the insufferably vulgar taste and paltriness displayed in many structures of the kind. Where the funds are so beggarly that nothing can be done, the most advisable course would be to attempt nothing beyond bare walls and a roof. Homeliness may be endurable, nay, even respectable, whereas the miserly show of miserable trumpery finery, of which many new churches are instances, is so far from being respectable, that it is almost indecent.

VI. Speaking of the recent competition for the Devon Lunatic County Asylum, the Western Times expressed the hope that there would be "a public exhibition of all the designs, *according to established custom in all archi-*

tectural competitions"! Unfortunately, the established custom is exactly the reverse of what the Western Times, in its simplicity or its ignorance, has conceived it to be. Any exhibition of the kind at all is quite an exception from the general rule, the established custom being not to allow the designs to be seen, if it can possibly be avoided; because, if they are, the comparisons made, and the opinions expressed, may be any thing but complimentary to the judgment and taste of the selecting committee. The public is a strongly inquisitive animal that, if not prevented, would be poking its nose in everywhere. It is an impertinent, busybody, mischief-maker, that would fain pry into all the arcana of competitions, and the ingenious secret manœuvrings and plottings of those who manage them. In short, the public is such a profane beast, that I wonder no one has contrived some mode of knocking it on the head at once. It is, therefore, to the honour of competition committees they do their best to get rid of it.

VII. "*Où la vertu va-t-elle se richer!*" was the exclamation of Molière on one well known occasion; and, substituting *virtu* for the other word, it was mine a few days ago, on quitting a bookseller's shop where a gentleman had been purchasing some very costly foreign works on art. "You have there a most excellent customer," said I, after the stranger had departed; "pray who may he be—is he a professional man, or some wealthy amateur?" "Perhaps you will be somewhat surprised when I inform you that that gentleman is no other than Mr. ——— of Fleet Street." "What! the same who keeps the ——— shop there? "The same." "And does he purchase many works of this description?" "Yes; he is a very different customer from Mr. ——— whom you saw here the other day, a bachelor with twenty thousand a year, and who has somehow got the reputation of being a person of great taste, an admirer and patron of the fine arts; yet, as you saw, stood haggling about a two guinea book, which he has not yet made up his mind whether to have or not. But perhaps," added my friend somewhat sarcastically, " as he has got the repuation for being a very great amateur of the fine arts, he may as well keep his cash in his pocket." "Hang him for a hypocritical curmudgeon! But I hope you do not find many of his stamp." "More, I am sorry to say among persons of that class, than would be generally supposed." "Yet among professional men of the wealthier sort, you must sell a great many foreign architectural works." "There, I assure you, you are quite mistaken; I have hardly a customer of the kind. There is Mr.———, Mr. ———, and Sir —— ——, all of whom it might be supposed would liberally encourage and subscribe to every architectural publication of importance, yet I have heard that they never buy a book at all, though they are by no means backward—two of them, at least, in *borrowing* them if they can." "Then the greater asses those lenders who accommodate such niggardly, skinflint borrowers. Such fellows would not be ashamed to borrow a dinner, and then return it *second-hand*. Do you find the nobility buy many books of the kind?" "I have very few indeed of them ever come here. My best customer of that kind is a lady—the Countess of ———, to whom I have sold a great many French and German architectural publications." "And the British Museum? inquired I. "Why, Sir, as to the British Museum, that, I suppose, you can answer for yourself. I dare say you know tolerably well what works of the kind are *not* to be found there." "Indeed I do; and know that while that national concern seems to be a repository for all the accumulated rubbish of our national *literature*, it is most shamefully defective in modern foreign publications on architecture and art generally.

HINTS ON ARCHITECTURAL CRITICISM.—Part 4.

The Recapitulation.

To reduce the foregoing observations into order: we discover architecture to be highly poetical, first, from the suggestive power which she exercises, that is, from her ability to move us towards some idea of beauty, or sublimity, by attitude, or the expression of forms, as also by relative position; and secondly, from her independence of mere proportion, which is essential only to delight, or that satisfaction which may or may not create delight. It will be seen further, that no attempt is made to trifle with constructive talent, nor to infringe on the properties and harmonies of proportion, the former of which may still be scientifically viewed, and the latter agreeably entertained: but it will be seen, that, for the purposes of criticism, architecture has been viewed as a fine art, and that as such, her power over the emotions has been briefly considered to support her claims to the rank of a fine art. We perceive that poetry does not necessarily imply imitation, but that arts which are not descriptive, or imitative, may induce emotion. It would be unphilosophical to retread ground, further to confirm what has been assumed, but it may be here remarked that compositions very often maintain their influence by the indistinctness of the idea they foster, and that what is so remarkable in poetry, viz., the sign of the effect, instead of the sign of its cause, being the origin of emotion, is also applicable in a similar way to architecture. The poet struck with some sublime idea, often paints the idea, rather than the cause of that idea, and this it is, which makes some of the denunciations of prophetic poesy so overwhelming: the mind having no definite idea of woe, but on the contrary:—and the cause is obvious, for the feelings of a poet being stronger than his reason, and those feelings being uppermost, he expresses *them*. Hence arises the power of poetry, which is never truer than when it exhibits its effects upon a mind. In the following passage from Isaiah, nothing can be more effective.—"*The noise of a multitude in the mountains, like as of a great people, a tumultuous noise of the kingdoms of nations gathered together; the Lord of Hosts mustereth the hosts of the battle.*" Here we have grand and mighty images, engulphing our reason;—confusion of *noises*, and *multitudes*, and *great people—tumultuous noises, kingdoms of nations—the Lord of Hosts—the hosts of the battle.* No one I think will contend against the poetic grandeur of such a description, if description it may be called, yet where can be found any thing about it, to give an adequately clear idea, of the movements of the Almighty, by whom, as Lord of hosts, we are arrested: we go indeed almost beyond the pale of nature by contemplation. I quote in this [illegible] from holy writ, not for the purpose of allowing the sublime images of the bible, to become the pivot of an argumentative treatise upon the power of art, but to show the origin of our emotion. Now in architecture, many a man has felt something of this, when entering the cathedral; and this does not arise from our love of antiqnity, which is quite different in its effects, and which I will hereafter try to make clear, but from the mysterious union of vastness and of infinity, of obscure images and of intricate beauties, amidst which reason is overwhelmed. So that, in judging of poetry, we very often judge of the emotion, and pronounce a composition as being good, or bad, according to whether the state of mind it is intended to plunge us into, is evenly, or unevenly sustained:—and this is essentially the province of criticism. And here I cannot help noticing the opinion which many entertain, of any attempt to reason philosophically upon works of art, in supposing that the promoter of such an attempt, is necessarily trying to lay down some fundamental law, by which the artist is to be ruled. It is impossible for any one, however vast his mind, or delicate his perception, or care, to regulate the artist in his choice or adaptation of materials, because the relations of a composition vary to infinity, and the mind, which could conceive a code of laws, would have to anticipate every possible relation. Criticism undoubtedly tends to invigorate and chasten, and one of the signs of refinement in any art, is the pure language and sentiment of its critics; but criticism is no more than an echo of sensibility subdued into a whisper, or swelling into praise, according as the judgment admits by degrees the full force of a composition. And all this accords precisely with a true definition of taste, for the degrees of difference between the opinions of a polished and an unpolished age, are, as the power of perceiving the influence of associations upon the mind. For be it remembered that the influence of associations varies, with our improved ideas concerning them; whilst a composition is not always judged by the intrinsic features of design, but by the ideas current concerning those features, and by the activity or stagnation of those ideas. Any one who has seen specimens of Indian carving, must have been struck with their representation of God, which they contrive by imitating no one thing, but by mixing what Horace ridicules in his art of poetry. Now they admire what we condemn and ridicule. We criticise their most adored objects of art by a smile, because our ideas of that awful being tell us that no attribute of his is exhibited. Had any barbarian of old exhibited his design to an Etruscan, in the days of Zeuxis, how would the Etruscan, versed from divination in forms, have smiled if the design had represented a group of animals? Just so is it with architectural criticism, which scarcely out of its cradle, begins to feel shocked at the vulgar opinions of cotemporaries, and this is the point I wished to arrive at, viz., to show the necessity to lay down some general idea of the duties of a critic, and of the vast field over which his sensibilities and judgment must move. I am aware that against such an attempt there are two objections; first, from the nature of the employment, which generally raises up an army of critics, like gnats to sting secretly and on the wing; and secondly, from that dearth of genuine poetry amongst us, which begets indifference to such themes; but I still hope to contend for the duties of criticism, satisfied that though such attempts be ridiculed now, they will not be hereafter.

Frederick East.

December 1841.

ON ARCHITECTURAL PRECEDENT.

No two classes of men appear to have so great a respect for precedent as lawyers and architects; by the one it is looked upon as of more importance than equity, and by the other it is appealed to as being a greater authority than any abstract principles of beauty or fitness; a judgment biased by the errors of our ancestors is considered as the best guide for conduct in modern times by the lawyer, and the architect uniformly persists in copying the designs of the ancients, however unsuitable they may be to the habits of the present day.

The universality of this prejudice in the case of the architect is evidently attributable to the system adopted in his education. A youth is taken into an architect's office, and the first principle of any importance that he learns is that "it is impossible to excel the ancients, and that the only thing we moderns can do is to copy their works:" he sees all around him engaged in making designs in accordance with the good old patterns, and is perhaps himself chiefly employed in preparing enlargements after some of the ancient examples: any natural taste that he may have for ornamental designing is checked, by telling him that he will never be able to come up to the works of our predecessors, and that he would be employing his time much better in studying the precedents handed down to us. The consequence is that he gradually imbibes the same veneration for antiquity that influences his seniors, and at the termination of his pupilage, instead of having had his natural creative talent brought to some perfection, he is probably as little capable of *originating* anything worthy of admiration as he was at the time he was articled; and he commences his professional career with the same determination to adhere to classic precedent that characterised his instructors; and this resolution being the result of a prejudice implanted in youth, is rarely to be removed by any arguments that may be adduced.

Surely it is sadly derogatory to the dignity of the profession, to have to acknowledge, that out of all the arts practised by the moderns, architecture forms the only case (with the exception of sculpture), in which the ancients have not been far outshone: such a conviction in the mind of an architect is certainly rather inconsonant with due respect either for himself or for his employment.

Is it then to be wondered at that there should be that want of public respect towards the profession frequently complained of by architects? Is it likely that society should entertain any high veneration for an art whose very professors acknowledge themselves to be mere copyists?

Many persons will say that painting should be included amongst the arts in which we have not excelled the ancients. Perhaps in no one case is the notorious gullibility of John Bull more glaringly instanced than in the almost universal veneration for old pictures; every one sets himself up as a critic in such matters, even though he never made use of a pencil or brush in his life, and if a specimen coming under his notice happens to have the appearance of age, it immediately elicits great approbation, probably expressed in a string of cant phrases, which he recollects to have heard used on similar occasions: if however any attempt be made to ascertain the meaning of these expressions, the interrogator may consider himself clever if he can identify any ideas attached to them; not one in fifty who affect to be judges of the old masters can really give any sensible reasons for the preference he pretends to have for their works.

The public generally are aware of the advantage continually taken by picture venders of this undue devotion to what is old; it is almost their everyday practice to secure some of the more spiritless of the modern paintings, and after having hung them for some time in a smoky room, and otherwise disguised their juvenile appearance, to palm them off upon these pseudo-connoisseurs as being some of the finest works of the old masters.

And yet notwithstanding the notoriety of this practice, and the conclusive evidence it affords that a great part of the supposed superiority of the old paintings is chimerical, the prejudice of society in their favour appears to be nearly as strong as ever.

The permanency of colouring, and the transparency of shade appear to be the only points in which we have been really excelled in this art by our ancestors. These are certainly two very desirable qualities, and their attainment is well worthy of attention, but after all they merely appertain to the mechanical department; the mixing of colours that shall be the most stable or the most transparent, can hardly be put upon a par with purity of artistical feeling or excellence of composition; surely the mere technicalities of the art are not to be compared with the grand imaginings of a Martin, or the exquisite truth of a Landseer.

The fact is that this affected admiration for the productions of our forefathers is only another development of that most abominable of maxims "*do as the world does*:" men mixing with society find it the custom to enlarge upon the inferiority of modern art, and to laud the ancients, and even though they may have sufficient taste to see the injustice of the censure, they acquiesce in the opinion rather than endure the sneers of their associates.

But to return.—In attempting to prove the possibility of improvement upon the architecture of former ages, I am triumphantly met by an opponent with the fact that there *have* been men who scorned to follow in the beaten track; who have struck out a new path for themselves, and have attempted to originate new styles but have signally failed. Now what is there to be surprised at in this? Is it likely that out of all the architects existing in England, that the man who happens to be the most independent and liberal minded should of course be the one best fitted to carry out his views, and to compete with the combined efforts of the ancients?

Is it likely that amidst all the opposition of the admirers of antiquity, the prejudices of the public, and the jeers of the profession, that he should succeed in his endeavours? Is it probable that when generation after generation have been engaged in servile copyism, and that all exercise of original taste has been discouraged under the belief that it was impossible to excel, that a man should spring up who should at once be able to vie with the efforts of those whose forefathers had been in the continual exercise of their powers of design? The faculty of creating new forms is obedient to the same laws that govern the other attributes of the mind, and is only to be developed by constant practice, and the transmission of the talent from father to son; and if this talent has been allowed to lie dormant for generations, its power will gradually be reduced, in accordance with the same law that what is no longer exercised to the same extent, no longer retains the same capability.

There is then no ground for surprise that the architects of the present day should be unable to produce any thing superior to what already exists; it is even probable that if they were unanimous in attempting to originate, they would all fall short of what has already been done: but what would that prove? not that it is impossible to fix up a higher standard than that hitherto attained, but simply that the faculty of design requires redevelopment, having lost ground from want of practice during the latter ages. In short to use something like a truism, it is evident that so long as architects retain the belief that they cannot excel the ancients, they never will.

The influence of precedent has been much increased by unfair criticism; it has been the universal custom to enlarge upon all the beauties of the old buildings, and to pass over all the defects, and on the other hand all the imperfections of the modern ones are sought out and magnified, and all the merits passed over as unworthy of remark. The fact is that to an unprejudiced eye there are in many ancient examples far more glaring errors than in any modern buildings of the same character. For instance, if I recollect rightly, in the nave of Glo'ster Cathedral, we have ranges of plain and massive Norman columns supporting small circular Norman arches, producing the impression of great stability, and then we find the adjoining aisles lighted by pointed Gothic windows, with all the usual characteristic lightness of this style of architecture. What can be more inharmonious than such a mixture? If one of the moderns had perpetrated such an incongruity, his reputation as a man of taste would have been irrecoverably lost.

Again, if one of the profession of the present day, a little more liberal than his brethren, happens in making a design in accordance with the style of some particular period, to introduce an ornament which was only used at some other era, although all the architects in England should not be able to offer any cogent reason why it should not harmonise with the other features of the building, he is at once sneered at by the critic, and stigmatized as a man of no purity of taste. But on the other hand if there should chance to be in the elevation of some cathedral a range of Gothic windows with angles of half a dozen different degrees of acuteness, producing evident want of unity in character, and any one draws attention to the fact as a great defect, the case is quite different—Oh, no! this is one of the works of our great ancestors, and we must not dare to criticise the designs of such superior men.

It is much to be regretted that such erroneous impressions respecting the ancients and their works should ever have crept into society: that same veneration for antiquity, is one of the greatest obstacles, not only to the advancement of architecture, but to the progress of every species of improvement. Perhaps no more effectual method could be adopted to lower the dignity of mankind, and to reduce the general tone of society, than to spurn the doctrine of the superiority of our predecessors: no method better calculated to produce want of confidence and consequent danger of incapability,

than to instil the belief that we have retrograded instead of advanced. And then to find not only that the impression is utterly erroneous, but that the truth is directly the reverse, and that the veneration of society is directed towards a people of whom it has been lately said by a talented author,* that "their history is a fable, and their philosophy a farce," makes the case still more to be deplored.

Perhaps it will be asked—how should this belief be so universal if it is without foundation? a very sensible question, but one to which there is no difficulty in finding an answer, and I may remark that the same cause that induces the feeling in society generally, is the origin of the predisposition of the same character in the architect. That cause exists in the present system of classical education.

H. S.

Derby, Dec. 15, 1841.

SIR FRANCIS CHANTREY.

The life of a man of genius, passed in the study, observes a celebrated writer, has few incidents but the production of his works, and in no case is this more true than in that of the distinguished sculptor whose loss to art we have to lament. Truly English as he was in his style, he had much contributed to the formation of the present school of art, at the same time it must be observed that his addiction to portraiture and neglect of the imaginative has not been without its influence in impeding the progress of high art. Under all circumstances, too, and considering how his chisel has been employed in celebrating the greatest men of the age, and how his works are distributed over every part of our vast empire, the name of Chantrey is indissolubly attached to the literary and artistical history of the age.

Francis Chantrey, the son of a farmer in Derbyshire, was born at Norton, a village in that county, on the 7th of April, 1782. Having been intended for the legal profession, he was taken to Sheffield to be articled to a solicitor, when a casual circumstance directed him to that career in which he was ultimately destined to attain so much honour. Having arrived before his friends, he was walking through the streets, and looking in the shop window of a carver and gilder, he felt such a strong bent for art, that he prevailed on his relations to apprentice him to the proprietor of the shop, a Scotchman of the name of Rogers, with whom he remained three years. Carving on wood, it is observed, was not his bent; before he was seventeen, he had applied himself to modelling in clay, and devoted his nights to that study. Having left the carver, he successively visited Dublin and Edinburgh, but not meeting with encouragement in either city, in 1808 he made his appearance in London, and soon found, in the exhibitions of the Royal Academy, the opportunity of making his genius known. A bust which Chantrey sent to the Academy attracted the attention of Nollekens, who, with his love of kindred art, exclaimed, "That's a splendid work, let the man be known; remove one of my busts, and put this in its place, for it well deserves it." The words were prophetic: the bust that of John Raffael Smith, was generally admired, and Nollekens, pleased with its success, took the artist under his protection, saying often to his friends, when applied to on the subject, "If you want a bust, Chantrey's the man." The late Earl of Egremont was another of the young artist's early patrons, and gave him a commission for the execution of a work in marble, but so rapidly did Chantrey's practice increase, that the work was never executed.

Early in his life Chantrey is said to have visited the Louvre, and inspected the magnificent collection of works collected by Napoleon from all parts of Europe. In 1816 our artist was elected an Associate of the Royal Academy, and in 1817 it was that he exhibited the celebrated group called the "Sleeping Children," erected in Lichfield Cathedral in memory of the two infant children of the late William Robinson. The homage paid to this work has been great, for when exhibited, young mothers are said to have wept over it, so affecting was the expression; for this work Stothard furnished the design. In 1818 he was elected a Royal Academician, and exhibited another well known work, the statue of Lady Louisa Russell when a child, now at Woburn Abbey. In the following year Chantrey visited Italy, and we find, among his works, a statue of Dr. Anderson executed for Madras, and monuments to Kirke White, Porson, and Fox Townsend at Cambridge. Chantrey, it may be observed, was much employed for India, many of his largest works having been executed for the three presidential cities. He had now a very great share of the public business, and a curious anecdote is told in relation to this. Handling the brush as well as the chisel, Chantrey sent in such a model for the George III. statue for Guildhall, that the wise men of the east intended to reject it on the supposition that the artist was a painter; and it was not until Sir W. Curtis sent for him to be examined on this point that the preference was given to him.

In 1820, 21, 22, and 23, we find few important works exhibited in the Academy, but his chisel was far from idle. In 1824 he exhibited his statues of the Countess of Liverpool and Dr. Cyril Jackson, but in the next year his name was wanting in the catalogue. In 1826 he began casting in bronze, and we find, among his works, bronze statues of Pitt for Hanover Square, Grattan for Dublin, and George IV. for Brighton, Windsor, and Edinburgh. He had also a commission from the United States for a statue of Washington. In 1827 he executed statues of Sir Joseph Banks for the British Museum, and Mr. Stephen Babington for Bombay. The only work exhibited in 1828 was a bust of Sir W. Curtis. The next year produced a statue of Sir Edward Hyde East, for the Court House, Calcutta, and a classical bas relief, and 1830, a statue of Bishop Heber. In 1831, he completed his statue of George IV. for Edinburgh, 12 feet high, and the coronation medal of William IV. and Queen Adelaide was executed by Wyon from his models. In 1832 he completed a statue of Canning for Liverpool, and in 1833 one of Sir Howard Elphinstone. From William IV. Chantrey received the honour of knighthood. In 1834, 5, 8 & 9, Chantrey did not exhibit, but in the intervening years he exhibited his statue of Sir John Malcolm, and one of Dr. Dalton. In 1840 our sculptor produced statues of William Roscoe, and of Northcote, the painter, and of Sir C. Forbes, and also an equestrian one of Sir Thomas Munroe. In the present year only two works were exhibited, namely his statues of the late Bishops of Norwich and Lichfield, executed for their respective cathedrals.

On the 25th of November, having only returned on the day before from a visit to the Earl of Leicester at Holkham, he died at his house in Eccleston Street, between eight and nine o'clock in the evening. In the morning he was in his usual spirits, inspecting the progress of the various works in his studio, and conversing cheerfully with his assistants: but during the day he had complained of illness, and had been compelled, by violent pains in his stomach, to return from Buckingham Palace, whither he had walked in company with a friend. He then received some medical advice from which he obtained relief. At seven he dined moderately as usual with a small circle of friends; but feeling unwell, he sent for a medical man, who directly required the attendance of his physician; but before the arrival of Dr. Bright Sir Francis breathed his last, it is supposed from apoplexy.

In person Sir Francis was under the average height, possessing a compact form and a highly intellectual countenance. He drew with taste, and engravings from his views in Dovedale were published; he was also an admirer of less artistic pursuits, having recently purchased a large geological collection for five thousand pounds. In his studio he possessed all the resources for carrying out great works, having for his assistants Allan Cunningham, who had been with him 28 years, Mr. Heffernan 30 years, and Mr. Weeks, and possessing a regular establishment for casting in bronze. He had in hand an equestrian statue of the Duke of Wellington, which is in a forward state, and he was appointed to execute the statues of Sir David Wilkie and Mrs. Siddons. Sir Francis Chantrey was a Royal Academician, Member of the Academies of Rome and Florence, and a Fellow of the Royal Society. He was married, and has left a widow but no children; his large fortune he is said to have bequeathed, after his Lady's death, to the Royal Academy, to be devoted to the promotion of the arts. Of him it may be truly said, that his good deeds will survive him, and that his fame and good report will live for ever.

Of his works we have not yet seen any complete catalogue, but will endeavour to furnish one as copious as our materials allow, with the dates of exhibition and places in which preserved.

Equestrian statues:—Wellington (Mansion House, not completed); Sir Thomas Munroe (Madras, 1840).

Statues:—George III. (Guildhall); George IV. (Brighton, Windsor, and Edinburgh); Washington (United States, 1826); Pitt (Hanover Square)

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* Philosophic Nuts, by Edward Johnson.

Grattan (Dublin, 1826); Canning (Town Hall, Liverpool, 1832, Westminster Abbey); Nelson, Dr. Dalton, Bishops Heber, (St. Paul's), Bathurst (Norwich, 1841), and Ryder (Lichfield, 1841); William Roscoe (Town Hall, Liverpool, 1840); Watt (Westminster); Nollekens (1840); Sir Joseph Banks (British Museum, 1827); Sir J. Malcolm (Westminster, 1837); Sir Howard Elphinstone (1833); Sir Edward Hyde East (Court House, Calcutta, 1829); Dr. Cyril Jackson (Oxford Cathedral, 1824); Countess of Liverpool (Kingston Church); Lady Louisa Russell (Woburn Abbey, 1817); Dr. Anderson (Madras, 1819); Marianne, daughter of Mr. Johnes of Staffold; Mr Babington (Bombay, 1827); Sir Charles Forbes (Bombay, 1840).

Monuments:—Sleeping Children (Lichfield, 1817); Majors General Gore, Skerritt, Bowes, and Hoghton, and Colonel Cadogan (St. Paul's); Matthew Baillie (Westminster Abbey); Admiral Bickerton (Bath Abbey Church); Mrs. Elwin (Bristol Cathedral); Kirke White, Porson, and Fox Townsend (Cambridge).

Busts, see Statues, Also William IV.; Queens Victoria (1840) and Adelaide; Duke of Sussex; Princess Louisa of Saxe Weimar (1833); Duke of Sutherland (1829); Marquis of Londondery (1821); Earl Spencer (1819); Lady Nugent (1820); Viscount Melbourne; Lord St. Vincent; Southey (1837); Scott; Sir Jeffrey Wyatville (1837); Sir John Soane (1830); Horace Hayman Wilson (Asiatic Society, 1837); Mrs. Somerville (Royal Society, 1837); John Raffael Smith; Wordsworth; Sir W. Curtis (1828); W. Manning (1819), Sir B. Hobhouse (1819); John Fuller, (1820); Sir Charles Clarke (1840); Dr. Mill (Asiatic Society, Calcutta, 1840).

The Waterloo Vase in the National Gallery is also by Chantrey.

DANNECKER THE SCULPTOR.

On the 8th October last, died at Stutgard, after a short illness, the well-known John Heinrich Dannecker, the Nestor of German sculptors. He had but a short time previously completed his 84th year. Stutgard was his native town, where he was born on the 15th of October, 1758, of poor parents. In spite of the disinclination of his parents, he determined, when very young, to turn his attention to the plastic arts, and by a personal application to Duke Charles of Wurtemberg, in whose stud his father was employed, he succeeded in gaining admission, in 1771, to the military artistical academy at the "Solitude," a Royal castle near Stutgard, where pupils were instructed free of expense in music, painting, and sculpture. The instruction he received here, however, was but a faulty one. It was in his 16th year that he carried off the prize for a model of Milo of Cortona. He next executed the Caryatides and other statues which at present adorn parts of the Royal residence at Stutgard. It was while studying in this academy that he made the acquaintance of his fellow-townsman Schiller, and of this friendship a lasting monument remains in the statue, which he afterwards took from life, of the illustrious poet. He left the academy in 1780, at the same time as the poet, and attained the situation of Court sculptor, with the paltry salary of 300 florins, or about 25*l.* per annum. The following year he was permitted to visit Paris, receiving, however, no further pecuniary assistance than that his salary was raised in the second year of his absence, to 400 florins.

At Paris he met with the sculptor Scheffauer, and became a pupil of Pajou. While in the French metropolis he devoted himself more to the study of nature than that of the antique models. In 1785 he left Paris with Scheffauer, with whom he travelled to Rome, where he became known to the immortal Canova, whose friendly instruction had a very beneficial influence on the youthful artist. It was here, too, that he made the acquaintance of Goëthe and Herder, then residing there in order to become acquainted with the stores of art which were contained in the Papal capital.

Whilst in Italy his excellent marble statues of Ceres and Bacchus first raised him to a greater reputation, and caused the academies of Milan and Bologna to choose him a member of their bodies. He subsequently returned to Stutgard, and was engaged for a long time modelling various subjects for Duke Carl. It was not till 1796 that he again began to work in marble, when he executed his celebrated Sappho, the original of which is now at Monrepos. After this and other ideal efforts he turned his attention to the taking of busts, and now it was that he took the likeness of Schiller before alluded to, a colossal copy of which graced his atelier. The then Crown Prince of Bavaria, now King Louis, employed him in various works, among which his bust of the celebrated composer Gluck is one of the most remarkable. The performance by which he is most known to the English lover of art is his delicious Ariadne as the bride of Bacchus, borne on a panther, which is to be seen in the house of the banker Bethman, of Frankfort. His Eros at the moment that Psyche is pouring on his shoulder drops of burning oil, according to the well-known Mythus of Apuleius, is also a beautiful piece of design. His best bust is supposed to be that of the physiognomist Lavater. But the *chef-d'œuvre* of the artist is his statue of Christ, for the idea of which he is said to have been indebted to a nocturnal dream. The completion, which took place in 1824, has cost him eight years of study and labour. It was then sent to the Empress Maria Feodorouna, of Russia, who afterwards made a present of it to the Emperor Alexander. The successful manner in which he succeeded in exhibiting Christ as the Mediator, and the divine expression which he imparted to the forehead of the statue, have often been the theme of praise. Thorwaldsen, who saw the model in the artist's workshop, expressed his opinion that the design of representing the Saviour as fully clothed would be a failure; undeterred by this, however, Dannecker maintained his original idea, deeming this as the most fit manner of treating the subject, and he succeeded in giving to the flowing drapery which envelopes the form a degree of lightness and truth seldom witnessed.

Dannecker's style was formed principally on the antique. His compositions are full of truth, life, and nature. His most distinguished pupil is Martin vor Wagner, Secretary to the Academy of the Fine Arts, at Munich. For some years he had ceased from all active employment, and had fallen into a state of second childhood and oblivion.

DR. BIRKBECK.

While recording the death of Sir Francis Chantrey, we little expected to have so soon to chronicle in our obituary, the name of a professor of the useful arts. In Dr. Birkbeck we have lost a man who has greatly contributed to the progress of education among working men. Although several individuals preceded him in the attempt, Birkbeck must certainly be considered as the founder of Mechanics' Institutions.

William Birkbeck was a member of an opulent and respectable family of the north of England, belonging we believe to the Society of Friends, but which they afterwards left. He was the son of a merchant and banker, and born at Settle in Yorkshire, in 1776. Having studied for the medical profession in the first instance at Leeds, he came to London and became a pupil of Dr. Baillie, afterwards removing to Edinburgh to complete his education. At that university he became the friend of Brougham, Jeffrey, Horner and Scott, and having distinguished himself by his attainments, he was appointed in his 22nd year Professor of Natural Philosophy, in the Andersonian Institution of Glasgow. It was while fulfilling the duties of this appointment that Dr. Birkbeck laid the foundation of the system of Mechanics' Institutions, and in 1822 he founded the London Mechanics Institution, of which he was for nearly twenty years the President, and which he aided both by his influence and his purse. He died on Wednesday the 1st of December, of a severe protracted illness, lamented and honoured by men of all parties and all ranks. He was twice married and has left behind him a widow and five children, three sons and two daughters, one by the first, and four by the second wife. As a physician he enjoyed much reputation and considerable practice, but as a philosopher and a mechanic his abilities were not less eminent. Dr. Birkbeck's mortal remains were interred in the General Cemetery at Kensal Green, and were attended to the grave by the members of the Mechanics Institution and many hundred people.

MR. THOMAS STEVENSON'S IMPROVEMENTS ON LEVELLING INSTRUMENTS.

Sir—In last month's Journal I perused with interest Mr. Townsend's observations on my improvements on Levelling Instruments. His remarks are in general judicious, but he appears to have misapprehended the main object which I had in view, and in some places he has entirely mistaken my meaning.

The rod is only 12½ feet long, and not 25 feet as Mr. Townsend supposed, and is divided as the old rods used to be divided in Scotland, to 10ths, 100ths, and either by vernier or appreciation to 1000ths. The object aimed at by me therefore was not to attain greater accuracy in the graduation of the sliding vane rod, but simply to save time in the use of that instrument. "For," (as Mr. Simms observes in his excellent Treatise on Instruments), "it not unfrequently happened in using the old staves that when by a succession of signals the staff holder had nearly brought the wire of the vane to coincide with that of the telescope, he would in his attempt to perfect it, remove the vane further from coincidence than at first." To obviate this defect, as I formerly mentioned in my communication to the Institution of Civil Engineers, I introduced a clamp to be used by signal when the cross hair of the instrument has been brought nearly to coincide with the centre of the vane, leaving the rest of the adjustment to be made with the screws. By this arrangement the great loss of time arising from the rough process of adjusting the vane by the hand is completely obviated, and the sliding vane rod, which is certainly the best instrument where great nicety is required, is thus freed from these objections. This instrument is therefore adapted to the most accurate purposes, always, excepting indeed researches such as those of Mr. Bunt, who read off to *four* places of decimals, while at the same time the self-reading graduation on the back of it renders it equally well adapted for every operation connected with engineering, and there is no reason, as Mr. Townsend seems to imply, why the readings should be pushed to a greater degree of accuracy than the wants of the observer, or the delicacy of his instrument may warrant.

With regard to the spherical or circular level which Mr. Townsend seems, so far as I can understand, to employ in a somewhat different way to me, I have to mention that my communication on that subject to the Institution is dated the 30th of January, 1841, although it was not read till the 4th of May. The great superiority of the spherical level as used by me consists in the *dulness of its motion*, a quality rendering it peculiarly fitted for the purpose assigned to it.

Mr. Townsend takes exception at the ball and socket joint, but I would observe that the surface of the ball which is in contact with the clamping zone is very considerable, and the friction produced so great that no unsteadiness is found to be produced by this construction in instruments for ordinary purposes. In such an instrument as a single second-level, which is only to be used for extraordinary purposes, I would not propose to adopt the ball and socket, as any method for saving time in setting such an instrument is of no value. In such a question as this, *experience is everything*, and I have to state that having now used that instrument on some 40 or 50 different occasions, I cannot forget the great facilities it has afforded, and the time it has saved me, more especially when a rising tide rendered time of paramount importance. I firmly believe that any one *after a day's experience of it*, would admit it to be the most desirable instrument he had ever used.

I remain, your obedient servant,
THOMAS STEVENSON.

Edinburgh, Dec. 10, 1841.

P.S. I do not consider it necessary to occupy valuable room in noticing the observations of Mr. Bewley.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

June 29.—HENRY ROBINSON PALMER, V. P. in the Chair.

The following were elected :—George Briant Wheeler Jackson, as a Graduate; William Crellin Pickersgill, William Millar, Robert Cantwell, Thomas Clark, and Hugh Roland Labatt, as Associates.

"*Description of the Bann Reservoirs, County Down, Ireland.*" By John Frederick Bateman, M. Inst. C. E.

The construction of the reservoirs described in this communication was undertaken with the view of regulating the quantity of water in the River Bann, and more effectually supplying water power to the flourishing and increasing establishments on its banks; this river is, from the bare and naked character of the Mourne Mountains, among which it rises, naturally liable to the greatest irregularity in its volume; devastating floods frequently pour down the channel, where a few hours previously there was not sufficient water for agricultural purposes: greatly injurious as this must have been to the agriculturalist, it was infinitely more so to the mill-owners, who depended entirely upon water power for their manufactories.

Mr. Fairbairn was consulted on the subject; he examined the locality, and advised the formation of reservoirs: the author was then appointed the engineer, and acting in some degree upon the suggestions of his predecessor, whom he continued to consult, the works were undertaken which are described in the present paper.

The peculiarities in the act of parliament, granted in 1836, constituting the proprietors of the mills a Joint Stock Company, for the formation of the Bann reservoirs, are detailed.

The works were originally intended to have been more extensive than have been really executed. The reservoir at Lough Island Reavy, is alone described: the ground in that spot was admirably adapted for the work, being the bottom of a basin, which was bounded on all sides by rugged hills of granite; in the centre of the basin was a small lake, at the bottom of which was discovered a bed several feet in thickness, of fossil confervæ, similar to those discovered by Professor Silliman at Massachusetts, North America. This interesting geological fact was first noticed by Dr. Hunter, of Bryansford; the confervæ appeared like an impalpable powder, but when viewed through a powerful microscope, they were found to be regular parallelograms, many of them covered with striæ. They are described by naturalists as the fossil skeletons of minute vegetables.

The situation fixed upon for the reservoir, rendered necessary the construction of four embankments between the hills, so as to raise the water to a height of 35 feet above the summer level of the lake.

These embankments were all constructed in a similar manner, only varying in the slopes and thickness of the stone facing according to the extent and situation.

The whole substratum of the valley was water-tight, either from the existence of the solid rock, dense clay, or of hard, compact, mountain gravel; so that there was no difficulty in securing the foot of the puddle. A trench was sunk into the water-tight stratum, whence the vertical puddle wall was carried up with the bank to the required height. It was 12 feet in width at 40 feet below the top, diminishing gradually to 8 feet wide at the summit, and was worked in regular layers of 8 inches in thickness.

The embankments were formed in concave layers 3 feet thick, each layer being completed before another was commenced, steps being cut in the ground where necessary, to receive the layers.

In order further to secure the tightness of the bank, a lining of peat 15 inches in thickness was brought up on the inside of the puddle, and a layer of the same material was laid upon the face of the slope; it was cut small, placed in thin courses like the puddle, and merely trodden down without more moisture than it naturally contained. The author advocates the use of peat in such positions, as, from its light and fibrous nature, in case of a leak occurring, the draught would attract into it all the fibrous particles, which by degrees would stop the holes sufficiently for the silt to settle over and effectually close the aperture.

Above the peat a course of gravel 3 feet in thickness was laid, and upon that the stone pitching, forming the inner side of the bank.

The inner slopes were for 20 feet below the top of the bank, 2½ horizontal to 1 vertical; the outer were 2 horizontal to 1 vertical; where they were deeper than 20 feet, the remainder of the backs sloped 3 to 1 on the inside, and 2½ to 1 on the outside.

All the embankments are 12 feet wide at the top, and 5 feet above the water level.

The centre of the deepest part of the embankment was traversed by a stone culvert, in which were placed two rows of cast-iron discharge pipes, 18 inches diameter, with suitable valves. A leak was discovered in the centre of the masonry of this culvert, occasioned by the engineer's instructions not being obeyed. The details of the methods employed for remedying this defect are given at length; as also those of the experiments upon cements made by the author after the data given by Vicat. The materials which were most accessible for the work were tested very carefully, and from the results, it was determined to employ mortar composed of rich Manx or mountain lime carefully slaked, and clay burned with peat in the open air. The proportions were 2½ of clay to 1 of lime. They were ground together, and being mixed with as much water as was necessary, the mortar was used immediately. The mortar for the backing had one measure of sand added; the grout had two measures of sand in it, and was used thin.

The concrete was composed of one part of lime, two and a half of calcined clay, and about three parts of sharp gravel.

This cement appeared to set hard, and to be perfectly tight; but when the reservoir was partially filled, several leaks were discovered, which rendered an examination necessary, and some energetic measures were taken to stop them, all which are described.

The result of the author's experience seems to be, that mortar made from rich lime and calcined clay, as recommended by Vicat, may set and harden under water when there is little pressure, but that it is not able to resist the pressure of a considerable depth of water.

The details of the construction of the masonry of the valve house, the fore bay, the waste weir, the bridge of three arches, constructed over the feeder from the river Muddock, and the various feeders for supplying the reservoir, are given at length, with the particulars of the expenditure of the sum of £14,891, which was the cost of the work, exclusive of land compensation, or salaries and professional charges.

The particulars are also given of a series of observations with rain gauges continued for two years, for the purpose of furnishing data for computing the extent of reservoir which would be necessary to insure a supply of water throughout the year.

The communication is accompanied by detailed drawings of every part of the works, and a plan of the district in which they are situated.

"*Description of a machine for sewing Flat Ropes.*" By Eugenius Birch, Grad. Inst. C. E.

In a previous communication, Mr. Birch described and gave drawings of the ingenious machinery invented by Captain Huddart: the subject was not entirely complete without the description of the present machine, which, although not of great importance in a scientific point of view, is well worthy of notice, in consequence of its being attached to this valuable rope machinery, and of its having been worked so successfully.

It is used for sewing or lacing together ropes, and forming them into flat bands, which are used for mining purposes, &c.

The bands or flats generally consist of four ropes, which are placed parallel to each other, and paired in contrary directions to the angle of the lay; being held under an equal degree of tension, they are sewn together with two cords se lines, by needles which are driven through holes previously pierced in the ropes, at an angle of 45 degrees, and the cords are then drawn tightly in a lateral direction.

That the ropes may be pierced more easily, it is necessary that the tar which they retain from the process of warm registering, should be softened; this is accomplished by passing them through a steam chest, whence they are drawn into a frame composed of four plates, which are placed so as to compress the ropes while they are in the softened state, and form a die which can be regulated to the size of the ropes required to be sewn. The piercing operation is performed in the die, which has slots in its sides for passing the piercers through.

There are not any recorded experiments on the strength of the ropes, but it is considered, that the amount of strength possessed by the flat rope is not equal to the sum of that of the four ropes before they were united; still the advantages of this mode of assemblage are so great, as to insure its preference in mining operations, and many other applications.

The drawings (which are numbered onward from the commencement of the set presented to the Institution, in the session of 1838*), display the entire machine, with details of all the parts.

End of the Proceedings, Sessions 1841.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Dec. 6.—P. Hardwick, Esq. R.A., in the Chair.

Mr. Hardwick opened the session by congratulating the members on the increasing interest shown in the proceedings of the Institute, and especially on the honour conferred on the Institute by His Royal Highness the Prince Albert, having graciously consented to become its patron, and on the arrangements which had been effected between the Committees of the Institute and of the Architectural Society, for a union of those bodies.—The Foreign Secretary, Mr. Donaldson, read letters from Sig. Clementi Folchi, of Rome, and Sig. Raffaele Politi, of Girgenti, acknowledging the honour conferred upon them by their being elected Honorary and Corresponding Members.

A paper was then read of the Great Pavilion erected at Liverpool, for the Royal Agricultural Society of England, by J. W. Wild. This paper will be found in another part of the Journal.

Dec. 20.—Jos. Kay, Esq., V.P., in the Chair.

Mr. Donaldson read a description of the Column erected on the Place de la Bastile, at Paris, to commemorate the last of the French revolutions, viz,, that of 1830.

The evening concluded by a concise and interesting description of the Escurial, compiled by Mr. Hayward, the Librarian of the Institute, and illustrated by a large plan.—The Institute adjourned for the holidays, until the 17th of January.

ARCHITECTURE IN MANCHESTER.

Whilst in London we hear too many complaints of the profession being overstocked, in Manchester, where, during late years the number of architects has doubled, all seem to be full of employment. No doubt this excitement is but temporary, being caused by the exertions of a party, who, despite the very general depression in the manufacturing districts, have succeeded in raising funds towards the erection of ten churches, some of which are actually in progress. In addition to these are other churches and chapels, and some public buildings, but few private mansions.

The first church we shall notice is from the design of Mr. E. Walters, an architect of considerable talent, who to much scientific and practical knowledge, unites the feeling and nice perception of the artist. It is in Granby Row, and stands on ground descending at a considerable angle from the street to the river, the retaining wall of which is about four feet from the east end of the church. The architect has surmounted these obstacles; and though the foundations swallowed up the sum of £480, he is confident of being able to complete the church for £2400. . It is to contain 800 people, 600 adults, and 200 children. The west elevation, which is all that is seen from the street, is of the early English style, and has been carefully studied. Mr. Walters is the architect of a larger church at Broughton Bridge, which is contracted for at £2950. The foundations had to be taken down to the depth of 12 feet. The church is built of brick and stone, and is in the Norman style, with two windows in each bay, whose heads are supported by shafts. The entrance door has Norman mouldings and shafts, and though with little ornament, is very good. The architect has shown some skill in overcoming the difficulties of his roof, which is in one span, and without a tie-beam, stability being *ensured* by inserting concealed rods, which, passing along the timbers, retain the feet of the principals. The church will contain 1100 people. Messrs. Cuffley and Starkey are the architects of a church near Pin Mill Brow, which will cost £3000, and will contain 1150 people. The level of the ground being considerably beneath the road, brick piers were carried up to support the beams, on which is laid the floor of the church. The pews under the galleries ascend in steps from the passage, and each person will look towards the opposite side of the church, as in the galleries above. The style employed is Norman, and the tower will be surmounted by a low Norman spire. Messrs. Cuffley and Starkey are also the architects of a church in Regent Road, which is also Norman. It displays some novelty in its windows, but appears faulty in its details. Miss Atherton has provided the funds for a large church in the new Stretford Road, the competition for which was gained by Messrs. Scott and Moffatt, of London. Mr. Moseley, of London, has lately been successful in a competition for a church at Red Bank. Mr. Pugin is at present building a large Catholic church, in the township of Hulme, which we cannot too highly praise. It consists of clerestory and side aisles, with roofs of very high pitch, and we have heard that a tower is to be raised at the angle. Its exterior in the flanks is very plain, being of red brick and stone, with early English lancet windows placed singly, the opening of each being little in comparison with the extent of neighbouring wall, and with a north porch and a south door, having shafts and very beautiful arch mouldings. The east end has early English arches, and a circular window. The interior of the church charms by means of its elegant proportions, its altars, its piscinæ, and other accessories of Catholic worship, which are here in all their integrity. We have heard some of those self-created critics who "rush in" with their opinions, though confessedly entirely ignorant of architecture, assert that the church was bad in design, that it was "like a barn." Oh! that instead of the paste-board Gothic of the church commissioners, we had some of those picturesque old barns. The Baptist chapel in the Oxford Road, just opened, is from the design of Mr. Walters. The sides will be enclosed by buildings, therefore enrichment is confined to the front, which is of stone, and in the early English rich style, with a centre door, over which is a two light window, the whole surmounted by the highly pitched gable and square pinnacles. The recess in the east, in which is the baptistery, is decorated with three early English arches. The whole was executed for £2300. These are not the only chapels in progress or just completed, but the others we were unable to visit. The Manchester and Birmingham Railway Station is a stupendous work, and has been performed with so great care, and with such good materials, that it may well last for centuries. It does not yet exhibit many of its decorative features. We noticed a building at the bottom of Market-street, which possessing some good points, is a glaring specimen of a bad modern mode of building. It fronts three ways, and the lower story is of shops, the ponderous superstructure appearing ready to crush the glass beneath. Leaving out of the question the bad effect of such a mode, it is positively insecure. The shrinking of timber bressummers is one part the cause of the cracks, which disfigure our buildings—and in case of fire, the whole front becomes one general ruin. In this case little is got by using iron, for the beams having become heated, snap when played upon with water. The Independent College stands about three miles south west of the town. It forms three sides of a square, and is understood to have cost £14,000. The front has two stories supported upon an arcade, and a bold entrance door leading to a flight of steps by which the hall and principal floor are gained. Over the door is a fine Oriel, and above rises the tower surmounted by an octagonal lantern. The style is that of the latest period of Gothic architecture, and is well kept up through the whole of its details.—Mr. Irwin is also the architect of a building in Pool Fold, which has the superimposed orders of the late Elizabethan, or early Italian school. In the neighbourhood of Cheadle, Mr. Atkinson, now of London, is erecting some Italian lodges of chaste design. This architect, whom we might fearlessly place at the head of modern professors of the Gothic style, has enriched the neighbourhood of Manchester with its best buildings. His church at Cheetham Hill has been already noticed in this Journal:—we merely stop to praise the great beauty of its details, which will prove a mine of study to all who carefully examine them. The church at Openshaw is much plainer than, though scarcely inferior in effect to, that at Cheetham Hill. It is in the early English style, with arcades and windows in the clerestory, similar to those in Beverley Minster. At the west a lantern rises from the roof, surmounted by a leaded spire.

Whilst we were in Manchester, a paper by Mr. Goldsworthy Gurney, was read at the Victoria Gallery, and excited much discussion, the subject on which it treated—that of Heating by Hot Water Pipes—

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* Journal, Vol. I. page 320.

having lately been much canvassed, in consequence of numerous fires having been ascribed to this cause. Mr. Gurney had found that heat can be carried through the air along a pipe, a distance of forty feet, sufficient to melt lead, and that these results took place with the *low* pressure pipes. The safety valve in certain cases was no protection. On placing stop cocks at certain distances along a pipe communicating with a boiler, he found that when the temperature was sufficient to burn saw-dust, an invisible and inflammable elastic fluid escaped. He advised that six inches of the circuit in pipes for heating be made of lead.—A new cement has been used at Manchester called Lithic cement, it is as hard as stone, and has a face as smooth as earthenware. It would be useful in the metropolis where our cements scarcely merit the name. In architecture generally, we were glad to see a gradual movement onward, and though the progress is slight, it is of that kind which augurs well for its continuance.

E. H.

December 1841.

REVIEWS.

Practical Essays on Millwork and other Machinery. By ROBERTSON BUCHANAN, afterwards improved and edited by THOMAS TREDGOLD, C. E., and now re-edited with the improvements of the present age, by GEORGE RENNIE, C. E., F.R.S., &c., 2 vols. 8vo., with numerous plates. London: John Weale, 1841.

THE name of Rennie would be embalmed in the history of millwork improvement, did it not possess still nobler claims to immortality. It was the father of the editor of the present volumes who first gave a real practical efficacy to those philosophical speculations which ascertained the true geometrical configuration of the elementary parts of wheelwork that was essential to produce uniformity of impulsive action and durability of operation. The millwork of the Albion mills was the first public manifestation of the late Mr. Rennie's abilities, and the improvements introduced by him upon that occasion gave an impulsion to millwright operations, such as the art had never before experienced, and of which it still feels the beneficial effects. It is little more than half a century ago that the teeth of all the millwheels in this country, with a few inconsiderable exceptions, consisted of nothing better than round wooden pegs. Smeaton accomplished some amelioration. But it was reserved for Rennie to give to millwheels their present form and structure, and the achievement would have been sufficient for his fame, had it not been thrown into the shade by those more brilliant triumphs of genius by which he is now almost exclusively remembered.

In opening a treatise upon millwright operations which has been published under the supervision of a son of this distinguished engineer, and who is himself already honourably known as a scientific and practical mechanician, our expectations were naturally commensurate with the auspicious quality of the circumstances under which the work had been produced. We cannot say that these expectations have been wholly disappointed. There is a considerable infusion of information in these volumes of the highest utility, and there is evidence of extensive erudition, and an intimate acquaintance with the subject. Yet the execution of the work is by no means satisfactory. There is a want of vigour and of unity discernable throughout the whole treatise—the needless prolixity of some of the chapters is extremely fatiguing to the reader—obscurity is not unfrequently produced by excess of simplification; and the arrangement, notwithstanding the exertions of an excellent analytical table of contents, is very much like the Gordian knot which no one can disentangle. We do not remember to have met with any work which required a more painful exercise of attention on the part of the reader, and this attention is not rendered necessary by the difficulty of apprehending recondite investigations, but by the difficulty of ascertaining the mutual relation of the several parts of the discourse—of unwinding the tangled thread of the enquiry. In fact these volumes can scarcely be regarded as a connected systematic treatise, they are rather a disorderly collection of miscellaneous papers of varying quality, from which the reader may make a selection, and which he must arrange for himself. In addition to Buchanan's original work with editorial notes and emendations, and two long papers in the form of appendices, besides supplementary definitions and other irrelevant matter, we have a vast number of "observations," "general observations," and "supplementary observations,"—the greatest part of them trite and trivial, mingling with the text, and dancing through every page in the most disorderly and fantastic array. The thread of the discourse is broken at every step, and the reader is almost tempted to throw a work aside which demands a severity of labour that bids fair to rival the toil of Sisyphus.

Another source of considerable perplexity is the absence of all means of determining what portions of the work are due to the original author, and what to his respective editors. Additions and commentaries are mixed up without scruple with the original text, so that we are utterly at a loss to know, unless by a reference to previous editions, to whom we are paying attention. After having listened for some time to Mr. Robertson Buchanan, we find that by some undivulged metempsychosis, he has been for some time changed into Mr. Thomas Tredgold, or Mr. George Rennie. In page 5, for example, it is observed, "Were the teeth of wheels infinitely small, their action would be regarded as that of cylinders simply touching, having the property required. The finite and sensible teeth given to wheels will therefore be of the most advantageous figure when one wheel conducts another, as if they simply touched; or, when their pitch lines have in every part of their revolution equal velocities. That teeth have this property when formed in a certain manner will be evident from the following proposition and its connexions." This quotation we find by a note at the foot of the page, to be a part of Buchanan's text, and we naturally conclude that the text continues to be Buchanan's until we receive some intimation to the contrary. But we have not advanced above a dozen lines further before we meet, "Before proceeding with *our author*, it will be," &c., whereas we imagined it to have been *the author himself*, we had all the time been listening to.

At what point in the compass of a dozen lines Mr. Buchanan has been transformed into Mr. Tredgold or Mr. Rennie, we have no means whatever of ascertaining. We are unable to distinguish between what is said by the one person and what by the other person without collating the different editions—without, in fact, ourselves editing a book we merely wish to read. In page 26, we read, "To make that part of a tooth which is within the pitch line or proportional circle, a straight line as proposed by *our author*, seems to be the most advantageous form;" and in page 27, "When part of the action takes place before the teeth arrive at the line of centres, the method of forming teeth proposed by *our author* (Art. 41), seems to be equal, if not superior to any other;" yet the article from which these quotations are taken are a part of the text, in no wise distinguishable as such from Art. 41. In page 44, we find, "It has been mentioned to me that the following rule in order to determine the length of the teeth of wheels is employed by the ingenious Mr. Murray of Leeds;" and a note at the bottom of the page accidentally shows us that this is a part of Buchanan's text, and in page 45, we meet, "On this rule *Buchanan* remarks that it does not seem founded upon any satisfactory principle." In page 34, "Sometimes it may be requisite to have but few teeth in the pinion. In such cases, in the conducted whether wheel or pinion, *Buchanan* preferred staves to teeth;" and in page 36, "Every one considerably experienced in wheel-work knows that when a pinion comes to be considerably worn, the friction is greatly increased. Whereas no such thing happens to the trundle." In a note referring to this passage, it is said, "This is a mistake, as trundles in consequence of the surfaces of contact being small, become soon indented by pressure, and cease to turn round in their sockets;" but whether it is Mr. Buchanan who makes this mistake or Mr. Tredgold, we have no means of finding out. We are inclined, however, to believe it is the latter gentleman, as Buchanan is usually distinguished by name, and five lines further on from the text we have last quoted, we meet, "It appears, however, to *Mr. Buchanan*, that a wheel might be made which would combine the advantages of both the pinion and trundle."

We will not tire our readers with further quotations upon this head, we might extend them indefinitely, and it is no extenuation to say that the value of the information rendered is unaffected by the name of the preceptor. The confusion of persons might be excusable if it were essential to achieve some highly beneficial result, but only upon that untenable supposition. The perplexity it occasions to the reader is extremely disagreeable—it creates moreover a species of responsibility such as might be expected to arise from anonymous authorship that is by no means beneficial or expedient. That in re-editing a work relating to the practical arts or inductive sciences, it is right to make such additions and corrections as are answerable to the progress of improvement, we do not deny. But we deny to any editor the right to mingle his own commentaries or speculations with the original text in such a manner that they are indistinguishable from it. What would have been the fate of all ancient authors if their successive editors had assumed such a prerogative? If Mr. Buchanan undergo many such purifications, we fear he will be sublimated altogether. Where a work by the suppression of any palpable errors, and the addition of separate supplementary notices, is incapable of being rendered answerable to existing conditions, it is much better to reject the piece of antiquity altogether in favour of a new treatise. There is little benefit in emulating the conservators of the ship of Colchis, who accomplished repair after repair until not a vestige remained of the original structure.

The definitions at the commencement of the volume, showing the precise acceptation of the terms wheel and pinion, trundle or wallower, teeth, cog, leaves and staves, are suitable enough, but we cannot see the utility of inserting in a work like the one before us, simple geometrical definitions, which may be found in several professional educational elementary works, besides about 20 pages filled with tables of square and cube roots. Surely the most moderate penetration might have discovered such insertions as these to be not merely superfluous, but to constitute a sort of "caput mortuum," highly detrimental to the quality of the work. Without conferring the smallest degree of benefit they create prolixity, induce confusion, and increase the expense of the book, at the same time that they diminish its value. Having said thus much on the superfluous part of the work, we shall now proceed to direct the attention of our readers to the more valuable portions.

The following remarks (page 192) are judicious.

> "Nor perhaps does the *simplicity* of a machine consist strictly in having *few moving parts.* If the parts of a machine be few, they are perhaps more easily taken in by the eye at one view, which may make them more easily comprehended by the mind, and in that sense be more simple. But in machinery the kind of simplicity at which we ought to aim has more regard to the *manner of action* than to the number of moving parts."

In page 95, we have a very useful table of the proportions of wheels in actual use, which we very willingly insert here.

TABLE OF PITCHES OF WHEELS IN ACTUAL USE IN MILLWORK.

Kind of Machine.	Horses' power.	Pitch in inches.	Breadth of teeth in inches.	Wheel.			Pinion.			Breadth proportionate to 10 horses power, and present velocity.	Present velocity per second, in feet.	Breadth in inches proportionate to 10 horses' power, at 3 feet per second, that is, reducing all the examples to the same denom.
				Teeth.	Revolutions per minute.	Diameter.	Teeth.	Revolutions per minute.	Diameter.			
						Ft, In.			Ft. In.			
Water-wheel[1], A.	10	4⅛	5½	..	..	..	..	..	..	..	..	5·5
Water-wheel[2], B.	30	3	10¼	304	3¼	24	3	318·47	..	3·41	3·95	4·489
Water-wheel, C	15	3	6	204	4½	16 2	44	20	3 6	4·	3·8	5·06
Water-wheel[3], D.	5½	3	4	207	..	16 5¼	50	..	3 11⅝	7·27	3·	7·27
Horse-mill, E	1	2¼	4	91	3	6 0½	22	12·9	1 5½	40·0	·949	12·65
Horse-mill, F	1	2¼	4½	91	3	6 0⅓	20	13·13	1 4	45·0	·949	14·23
Steam Engine, by B. & W. G.	24	3¼	6	96	19	8 0	42	43·32	3 6	2·5	7·95	6·625
Steam Engine, by B & W. H.	46	3	8	152	17½	..	54	50	..	1·7	11·	6·2
Steam Engine, by B. & W. I.	32	3	6	116	19	8 10	..	..	..	1·87	8·78	5·47
Steam Engine, by B. & W. K.	14	3	5	64	25	5 1	29	55	2 4	3·57	6·65	7·91
Steam Engine, L.	20	2½	5	90	18	5 11	38	42·63	2 7	2·5	5·57	4·64
Ditto, ditto[4], M	10	2¼	5¾	77	25	4 7⅕	40	48·5	2 4⅝	5·75	6·2	11·88
Ditto, ditto[5], N	6	2¾	5¼	60	28	3 7	27	62·6	1 7⅝	8·75	5·25	15·31
Ditto, ditto[6], O	4	2¼	4¾	48	32	2 10⅕	25	61·11	1 6	11·87	4·8	18 99
Ditto, ditto, P.	2	2	4½	62	..	3 6	..	..	2	3·75	8·8	11·
Ditto, ditto[7], Q	10	1⅘	6	77	25	3 10	40	48·5	1 11⅕	6·	5·	10.
Ditto, ditto, R.	12	1⅜	3	66	44	2 8	48	60·5	1 9	2·5	5·99	4.95

1 Has been 16 years at work. Teeth much worn.
2 Has been 16 years at work. This gearing was found rather too narrow for the strain, as it is wearing much faster than the rest of the wheels in the same mill.
3 The only defect in this gearing, which has been 16 years at work, is the want of breadth in the spur-wheel and pinion: they ought to have been 6 inches or more, as they will not last half so long as the bevel-wheels and pinions connected with them.
4 This is a better pitch for the power than Q.
5 This wheel has wooden teeth, and has been working for three years past.
6 Ditto.
7 This pitch has been found to be too fine.

EXPLANATION OF THE TABLE OF WHEELS IN ACTUAL USE IN MILLWORK.

The wheels are all reduced to what may be called one denomination.

First—By proportioning their breadths all to what they should be to have the same strength, if the resistances were equal to the work of a steam engine of ten horses' power.

Second—By supposing their pitch lines all brought to the same velocity of three feet per second, and proportioning their breadths accordingly. I have chosen this particular velocity of 3 feet per second, because it is the velocity very common for overshot water wheels.

Such cases as appear to have worn too rapidly, are marked, which may tend to discover the limit in point of breadth.

The Appendix A on the teeth of wheels by Professor Willis, is an important and well written paper, already known to the public, through the Reports of the Proceedings of the British Association, at the meeting held at Newcastle, and the Transactions of the Institution of Civil Engineers. The leading feature of this paper is the development of a method of making any pinion to work correctly with any wheel of the same pitch. The following extract explains the manner in which this is accomplished.

> "From among the infinity of curves that may be offered the epicycloids and involutes have been universally preferred, on account of the facility with which they can be mechanically described, and perhaps because they admit of ready and independent demonstrations of their possessing the properties required. But the practice has hitherto been confined to that class of epicycloids which work correctly with straight lines or circles. Teeth formed upon these principles possess this inconvenience, a wheel of a given pitch and number of teeth, say 40 if it be made to work correctly with a wheel of 50 teeth of the same pitch, will not work correctly with a wheel of 100 teeth of the same pitch. This is obvious, for the diameter of the describing circle by which the epicycloid is formed must be made equal to the radius of the pitch circle of the wheel with which the teeth are to work, and will therefore be twice as large in the second case as in the first.
>
> In the old style of millwork in which the teeth of wheels always consisted of wooden cogs, this property offered no very serious impediment, although as we shall see it introduced some complication of method; but in the modern practice of making cast iron wheels the objection is a very serious one. A founder must make a new pattern of a wheel of 40 teeth for every combination that it may be required to make of this wheel with others, and the same for a wheel of any other number. Besides, it often happens in machinery that one wheel is required to drive two or more, whose number of teeth are different, and in this case the teeth cannot be correctly formed at all on the common principles; and again the perfection of machinery is impaired from the temptation to employ in one combination patterns which have been formed for another combination very nearly the same, for example, to make a wheel of 40 teeth that has been formed to work with one of 80, serve for a required combination of 40 with 85.
>
> "It is essential therefore that the teeth of wheels should if possible be so formed as to allow a given wheel to work correctly with any other wheel of

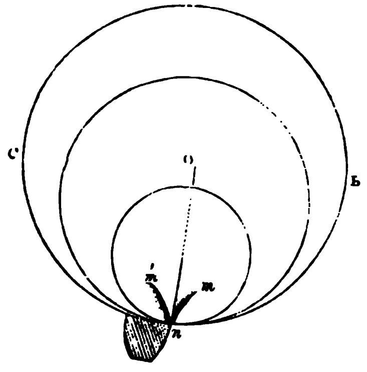
the same pitch. Now it has long been known that involute teeth have this property, but the objections to these teeth on the score of the obliquity of their action have operated fatally against their introduction. I shall now therefore explain a method of imparting to epicycloidal teeth this property, and that without making them deviate very much from the general form which has been established by practice.

"To effect this it is merely necessary to employ a proposition well known and stated by almost every writer on the subject, namely, if there be two pitch circles touching each other, then an epicycloidal tooth formed by causing a given describing circle to roll on the exterior circumference of the one will work correctly with an interior epicycloid formed by causing the same describing circle to roll on the interior circumference of the other. This proposition having been already demonstrated, it is unnecessary for me to dwell upon it longer than to remark that our author (Buchanan) like all other writers on the subject, has passed from it to recommend for practice that particular case of it in which the describing circle being made equal in diameter to the radius of the pitch line, the interior epicycloid becomes a radial straight line, the inconveniences of which practice I have shown. The following corollary is I believe new, and constitutes the basis of the system I propose to explain.

"Corollary.—*If for a set of wheels of the same pitch a constant describing circle be taken and employed to trace those portions of the teeth which project beyond each pitch line, by rolling on the exterior circumference, and those which lie within it, by rolling on its interior circumference, than any two wheels of this set will work correctly together.*

"For in the first place it is well known, and can be shown from general principles, that the portion of tooth *within* the pitch line of a driving wheel works only with the portion that lies *beyond* the pitch line of its follower, and that its action is confined to the approach of the point of contact to the line of centres. After the point of contact of the teeth has passed that line, then the case is reversed, and the portion of the driving tooth which lies *beyond* the pitch line is in contact only with that part of its follower's tooth which lies within its pitch line. Now as a constant describing circle is used for the whole set, it is clear that the proposition will apply to any pair of wheels both before and after the teeth have passed the line of centres, for in each case we have an exterior epicycloid working with an interior epicycloid, and both have been drawn by the same describing circle, that is, by the constant circle of the set.

"To carry this scheme into practice it only remains to settle the proper diameter to be given to this constant describing circle, which may be done by considering the effect of this (its) diameter has upon the form of the tooth.



"Let B C *n* be a pitch circle whose centre is O, then upon this system the flank of the tooth or that portion which lies within the pitch circle will be an arc of an interior epicycloid (or hypocycloid) *m' n* or *m n*. Now if the describing circle be of half the diameter of the pitch line, the flank will become a straight line coinciding with the radius O *n*. If the describing circle be of less than half the diameter of the pitch line, the flank *m n* will be concave, and the base of the tooth will spread. But if the describing circle be more than half the diameter, the flank *m' n* will be convex, and the base of the tooth lessen inwards, a form manifestly unpractical and useless. Hence the describing circle must not be greater than half the diameter of the pitch line.

"On the other hand if the diameter be too small the base of the tooth will spread inconveniently, and the curvature of the exterior epicycloids be injuriously increased, therefore on these grounds it should be made as large as it can, consistently with the limitation just stated, so that we finally obtain this rule for finding the diameter of the constant describing circle for a set of wheels.

"Make it equal to the radius of the least pitch circle of the set.

"And as pinions should never have less than 12 or 14 teeth, it would be well to establish one of these numbers as the least pitch circle.

"The proposition and corollary being perfectly general, will apply to racks which must be considered as (portions of) very large wheels, and also to annular or internal wheels. Accordingly, if the constant describing circle be employed in tracing their teeth, they will work correctly with any wheel of the set."

In page 149, Professor Willis describes a mode of drawing the teeth of wheels by means of compasses, that will work upon the preceding principles, and which, though not mathematically exact, is sufficiently so for practical purposes. We shall endeavour to describe this method without the aid of a diagram.

First describe the pitch circle—draw a diameter, and from the extremity of the diameter, with a radius of one-fourth of the diameter, set off an arc of the pitch circle. The point of intersection is the centre from which with the same radius, that part of the side of the tooth extending beyond the pitch line is to be swept. To describe that portion of the tooth within the pitch line, draw a line through the extremity of the diameter, which makes an angle of 75°, with the line of centres, and fix upon a point in this line sufficiently low down to give a moderate concavity to the inner portion of the tooth when swept from that point as a centre. In the description of this method in page 149, the word "radius" is twice put for the word "diameter." There are various similar mistakes in other parts of the work.

The Appendix B on Roofs, by Mr. James Nasmyth, is a highly interesting paper, it explains the great utility of the lathe with the slide rest, and its importance to engineers.

The plates attached to the work are for the most part excellent, they exhibit several splendid specimens of machinery to be found in the manufactories of government and mechanical engineers of the first class. The typography is of the very first quality, and reflects much credit upon the parties concerned in the production. Notwithstanding the imperfections we have pointed out, the work will, we are confident, meet with an extensive sale. The subject of millwork is an important one, and there is no better treatise upon it than this edition of Buchanan's essays.

The Companion to the Almanac, 1842.

Our Christmas companion always affords us much pleasure, containing as it does a general view of the progress of many public works in this country. In the volume for the present year, we have some very excellent specimens of architecture, which clearly show that we moderns are not quite so far below the ancients as to be unworthy of notice. Liverpool before many years will have in St. George's Hall and the New Assize Courts, judiciously combined under one roof, and forming a splendid façade of the Corinthian order 420 feet in length, with a portico in the centre of 200 feet, one of the most splendid buildings in the country. The name of the talented architect is Mr. W. H. Lonsdale Elmes, the son of Professor Elmes, and it is with pleasure we learn that he is a very young member of the profession, for the design is one of promise. Sincerely do we hope that the Liverpool corporation will not frustrate him in carrying out his views; if allowed to carry out the design to the extent he proposes, Liverpool may then be justly proud of having a noble edifice.

By the same architect there is also another building, and in the same town, the Liverpool Collegiate Institution, which shows that Mr. Elmes is equally able in the Gothic as he is in the classic. The wood engraving, which is very badly got up, does not do the architect justice; we fortunately have seen the drawings and can speak of the building from them, and hope that we shall be able to illustrate our Journal with a view of the building, together with that of *St. George's Hall.* The other buildings illustrated in the book before us, are *Streatham Church*, architect, Mr. Wild; *St. Mary's Church, Southwark*, architect, Mr. B. Ferrey, who, as our author observes, has shown great discretion in not attempting too much, but endeavouring to produce effect by form rather than by decoration. *Trinity Chapel, Poplar*, architect, Mr. Hoskins; he has displayed considerable judgment in the construction of the roof, by which means a clerestory, is very ingeniously obtained, "containing five windows on each side over the galleries, and is formed within the general line of the roof in such a manner that it is not visible externally."—*Savings Bank, Bath*, architect, Mr. Alexander. "The structure is entirely faced with freestone, and is a tasteful piece of Italian *astylar* composition stamped by certain vigour and breadth.

We perceive that Oxford is making progress with its various architectural works.

Bartlett's Index Geologicus.

This is a diagram 3 ft. 6 in. by 2 ft. 9 in., containing a coloured section of all the geological strata, with complete catalogues of the fossil animal and vegetable remains, and of the series of minerals peculiar to each. Another column contains "statistics of the soils and indigenous flora," and the localities where the separate strata prevail, not only in Great Britain, but in other parts of the world, are particularly specified.

As a complete table of convenient reference, embracing in a highly condensed form and great body of information which had heretofore to be sought amid heaps of scattered materials throughout the works of many different authors. We strongly recommend the *Index Geologicus* to agriculturists, engineers, students in geology, and all others interested in this most important branch of natural history.

A Description and Historical Account of the Churches in the Division of Holland, in the County of Lincoln, with Illustrations. By Stephen Lewin.

The first number of this work contains views of Kirton Church and Algarkirk Church, and also a view under the Tower of Boston Church. To those who feel an interest in the many splendid Churches to be found in the rich diocese of Lincoln, we recommend a look at this work.

Tyas's Geology of England and Wales. By Samuel Hughes, C.E.

We have before us Part the first of a cheap Geological Atlas, which contains a map of the district round the metropolis, with a description. The editorship has been entrusted to Mr. Samuel Hughes. and the work appears to us for accuracy to be superior to any of its predecessors, while being at the same time a detailed map, it is much more available for all purposes.

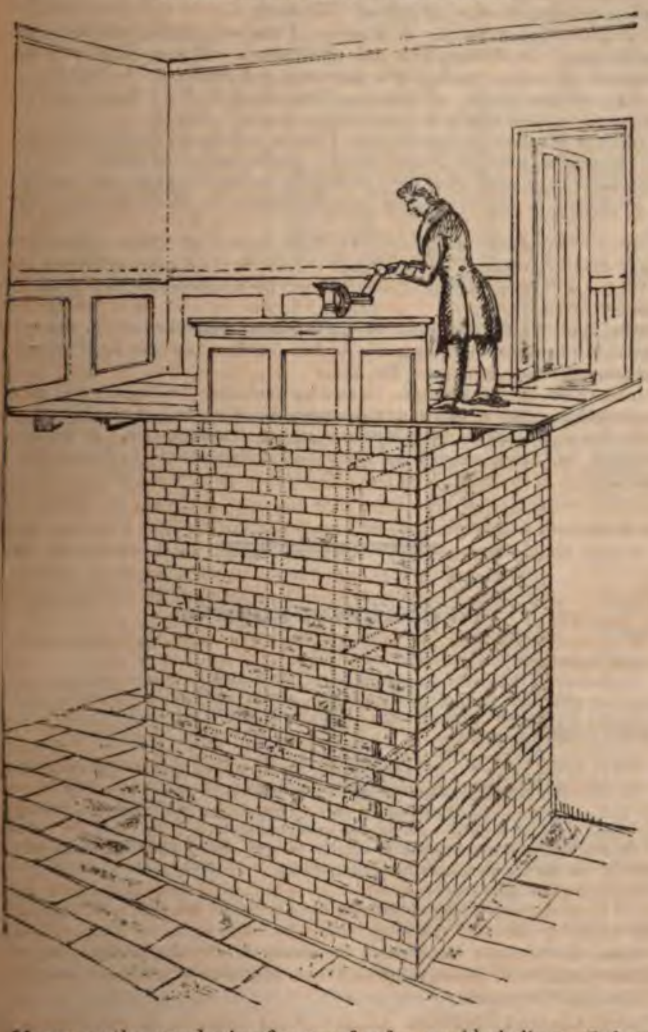
The Railways of Great Britain and Ireland. By Francis Whishaw, C.E., &c. Additional Plates.

This is an interesting Addenda to Mr. Whishaw's large work, which we noticed a few months since; the first plate shows the length, summit, and general levels of the main English lines above the Trinity high water datum—the next plate contains drawings of six different wheels in use upon railways, the third and last plate is a curious diagram exhibiting at one view the prices of railway shares on the London Stock Exchange, from the first commencement of the railway to the end of October 1840.

An Essay on Architectural Practice. By T. L. Walker, Arch. F.R.S.B.A.

This essay is the first section on the construction of general working drawings; it contains the contract drawings, specification and bill of quantities of one of the New Churches built under the author's superintendence, in the vicinity of Bethnal Green. The drawings are shown with great clearness, with their dimensions correctly marked thereon, and the specification is well drawn, detailing with great perspicuity the nature of the work to be executed. The student will find this essay a good example for study, to whom we strongly recommend it.

CHUBB'S PATENT WELL-SAFE.



MANY parties purchasing fire-proof safes, would gladly avail themselves of the further security, by depositing them in a well, or pit, under ground; but they have been unable to do so, in consequence of the space required, and cumbrous nature of the apparatus hitherto employed in raising and lowering the safe: Mr. Chubb has provided against this inconvenience, by his newly-invented apparatus, as shown in the annexed engraving.

The Safe, which stands in its appropriate place in the counting-house, may be lowered to any depth, by means of machinery concealed in a protecting encasement under the floor; the movement is effected by means of mechanical action, which any individual can perform, and the Safe is lowered or raised, in an inconsiderable time, without noise, or the possibility of danger to any one. But an additional safety, of special importance, that of concealment to the whole, is provided by the iron fire-proof door, level with the floor of the apartment, and secured by a strong detector lock, with bolts throwing each way. It will be at once obvious, that this mode of securing the Safe under ground, will afford effectual and entire security against the most extraordinary ravages of fire, or the danger arising from the occasional violence of riotous attacks for the purposes of depredation.

MISCELLANEA.

Knightsbridge Improvements.—The Cannen Brewery and the Fox and Bull public-house have been taken down to make room for a splendid architectural entrance into Hyde-park, to be called the "Albert Entrance." The houses on either side along the park, extending to the Horse Barracks, belong to the Dean and Chapter of Westminster. In former times, prior to the dissolution of the monasteries by Henry VIII., where Lowndes-square stands was a coppice which supplied the Abbot and convent of Westminster with fuel; and even to this day the Westminster scholars are permitted to burn large logs of beechwood in their dormitory. which are now supplied by the College porter. Westminster Abbey has been, from a very distant period, supplied with spring water from an aqueduct at Bayswater, communicating to a very pretty Gothic conduit-house erected by the Dean and Chapter at the lower end of the Serpentine in Hyde-park. The pipes are leaden, and although they have been under ground for many centuries are yet perfectly sound. They pass through the Green-park and the end of the ornamental water in St. James's-park, at the spot where a stone is erected, and through Queen-square, to the Abbey.

The Improvements in Threadneedle Street.—The building which is now in the course of erection on the site of the old French Protestant church, in Threadneedle-street, has, for some time past, attracted the attention of all passers-by, although it is not yet completed, nor likely to be so for some months to come, on account of the nature of the ornamental designs, which require the strictest attention on the part of the artists employed. The basso-relievo is intended to occupy the whole extent of the front of the building. The skill and taste displayed in the erection of this new edifice are well worthy of the attention of all lovers of the fine arts, who will do well to take an opportunity of visiting it. The proprietor, who bought the ground from the city authorities, after it had been determined to pull down the old French church, very handsomely conceded to the latter, without receiving any consideration whatever, 10 feet of the entire frontage, for the express purpose of giving that additional width to the street, the narrowness of which has always been found so excessively inconvenient. This disinterested conduct on the part of an individual should, and doubtless will, call forth a corresponding feeling on the part of the city authorities, who, with this example before them, are, as it were, bound to proceed with the improvements, and to continue the additional width throughout the whole extent of Threadneedle-street. If the whole of the northern side of the street, from Old Broad-street to the Old South Sea House, were taken down, and thrown back a space of ten feet, in order to correspond with the building in question, a noble street would be formed, well calculated to make a fine approach to the new Royal Exchange. In fact, we know of no part of London where a greater display of elegant architecture will be found, than that which will be exhibited in the course of next year in the immediate vicinity of Cornhill and Old Broad-street, &c.

Sunderland.—Last month the New Church, recently erected at Deptford, was consecrated. It is built in the early English style of architecture, and is large and commodious, being 110 feet 9 inches long by 54 feet broad. There are three galleries in the church, which is altogether capable of seating about twelve hundred persons, nine hundred of which are free sittings. The architect is Mr Thomas Moore, of Sunderland.

Professorship of Architecture, University College.—The movement as to architectural professorships continues. Mr. Donaldson has been appointed to the chair in University College, London, a choice which will be of advantage to the college and profession.

"*The Thames*" *Steam Ship.*—This splendid vessel, built for the West India Mail Steam Packet Company, made a trial trip on 14th ult. She was built by Mr. Pitcher, of Northfleet, and is a fine specimen of naval architecture for standing sea service, and at the same time having every convenience for passengers. For making the passengers comfortable every contrivance that could be introduced has been thought of, while the saloons have been fitted up with great taste and beautifully decorated. The engines were constructed by Messrs. Maudslays and Field, and are of 400 horse power, being made from the same models as the Great Western, which have done so much credit to the talented engineers. The speed attained at the trial mile in Long Reach was about twelve miles through the water.

The King of Prussia has given orders for the restoration of the palace at Coblentz, and it is supposed that the Rhenish States will meet there and at Dusseldorf alternately. The King has ordered 50,000 dollars for the building of the cathedral at Cologne, and has promised from the treasury 30,000 dollars yearly, in addition to sums for the purchasing up the houses at present surrounding that magnificent building.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 25TH NOVEMBER, TO 23RD DECEMBER, 1841.

Six Months allowed for Enrolment.

Robert Wilson, of Sowerby Bridge, Halifax, currier and tanner, for "*improvements in the manufacture of leather.*"—Dec. 2.

William Irving, of Princes-street, Rotherhithe, gentleman, for "*improvements in the manufacture of bricks and tiles.*"—Dec. 7.

James Colman, of Stoke Holy Cross, Norfolk, starch manufacturer, for "*improvements in the manufacture of starch.*"—Dec. 9.

William Henry Fox Talbot, of Lacock Abbey, Wilts, Esq., for "*improvements in coating or covering metals with other metals, and in colouring metallic surfaces.*"—Dec. 9.

John Hall, of Breezes Hill, Ratcliff Highway, sugar refiner, for "*improvements in the construction of boilers for generating steam, and in the application of steam to mechanical power.*"—Dec. 9.

Archibald Templeton, of Lancaster, silk spinner, for "*a new or improved method of preparing for spinning silk and other fibrous substances.*"—Dec. 9.

Jonathan Guy Dashwood, of Ryde, Isle of Wight, plumber, for "*improvements in the construction of cocks and taps.*"—Dec. 9.

Moses Poole, of Lincoln's Inn, gentleman, for "*improvements in the construction of masts for ships and vessels, and in applying the shrouds.*"—Dec. 9. (A communication.)

Josiah Taylor, of Birmingham, brass founder, for "*improvements in the construction of lamps.*"—Dec. 9.

Robert Henderson, of Birmingham, china dealer and glass stainer, for "*certain improvements in apparatus for heating and lighting apartments, and for other like purposes.*"—Dec. 9.

Henry Wilkinson, of Pall Mall, gun maker, for "*improvements in machinery to be used in constructing buildings, and in raising and lowering weights and materials.*"—Dec. 9. (A communication.)

John Edwards, of Shoreditch, warehouseman, for "*improvements in giving signals on railways.*"—Dec. 11.

William George Henry Taunton, of Liverpool, engineer, for "*improvements in machinery for raising weights.*"—Dec. 11.

William Westley Richards, of Birmingham, gunmaker, for "*improvements in the construction of gun and pistol locks and primers for the discharge of fire arms.*"—Dec. 14.

William Edward Newton, of Chancery-lane, civil engineer, for "*improvements in printing and delineating patterns, and printed cloths for floor cloths, covers, and other uses.*"—Dec. 14. (A communication.)

Francis Mar, of 81, Eaton-square, Esq., for "*certain improvements in the construction of ships or other vessels, and the method of propelling them.*" Dec. 16. (A communication.)

William Neilson, builder, David Lyon. builder, and Peter M'Onie, engineer, all of Glasgow, for "*improvements in cutting, dressing, preparing, and polishing stones, marble, and other substances, and also in forming flat or rounded mouldings, and other figures thereon.*"—Dec. 16.

Charles Edward Austin, of Fulham, engineer, for "*an apparatus for what is commonly called 'changing the line,' on railways.*"—Dec. 16.

James Stewart, of Osnaburg-street, Regent's park, pianoforte maker, for "*an improvement in the construction of castors.*"—Dec. 16.

William Prowett, of Northamptonshire, victualler, for "*improvements in giving signals on railways.*"—Dec. 16.

Henry Booth, of Liverpool Esq., for "*improvements in the method of propelling vessels through water.*"—Dec. 16.

John Norton, of the Junior United Service Club, Regent-street, Esq,, for "*improvements in sheathing ships and other vessels.*"—Dec. 16.

Antoine Mertens, of the London Coffee-house, publisher, for "*improvements in the manufacture of plaited fabrics.*"—Dec. 16.

William Church, of Birmingham, civil engineer, and Jonathan Harlow, of the same place, manufacturer, for "*improvements in the mode of manufacturing metallic tubes, and in the mode of joining them, or other tubes or pieces, for various useful purposes.*" Dec. 16.

Thomas Starkey, of Birmingham, copper cap manufacturer, for "*improvements in percussion caps for discharging fire-arms.*"—Dec. 16.

John Americus Fanshawe, of Hatfield-street, Christ Church, gentleman, for "*an improved manufacture of waterproof fabric, applicable to the purposes of covering and packing bodies, buildings, and goods, exposed to water and damp.*"—Dec. 16.

William Buckwell, of Trinity-street, Borough, civil engineer, for "*improvements in scaffolding or frame-work for building purposes.*"—Dec. 16.

Charles Loosey, of Half-moon-street, Piccadilly, civil engineer, for "*improvements in steam-engines, and which improvements are also applicable in raising or forcing water and propelling vessels.*"—Dec. 16.

John Bould, of Overden, Halifax, cotton spinner, for "*improvements in condensing steam-engines.*"—Dec. 16.

Antoine Jean Francois Claudet, of High Holborn, glass merchant, for "*improvements in the process or means of, and apparatus for, obtaining images or representations of nature or art.*"—Dec. 18.

Henry Hough Watson, of Bolton-le-Moors, Lancaster, consulting chemist, for "*improvements in dressing, stiffening, and finishing cotton, and other fibrous substances, and textile and other fabrics, part or parts of which improvements are applicable ta the manufacture of paper, and also to some of the processes or operations connected with printing calicoes and other goods.*"—Dec. 21.

William Edward Newton, of the Office for Patents, 66, Chancery-lane, civil engineer, for "*improvements in lamps and burners, and in the means of supplying air and heat thereto, for the support of combustion.*"—Dec. 21. (A communication.)

William Newton, of the Office for Patents, 66, Chancery-lane, civil engineer, for "*improvements in cleansing wool, and facilitating the operation of dyeing; and also in washing and bleaching cotton yarns or fabrics.*"—Dec. 21. (A communication.)

Ovid Topham, of Whitecross-street, engineer, for "*improvements in engines, machines, apparatus, or means for extinguishing or stopping the progress of fire in any room or part of different buildings, which may have become ignited, such as noblemen or gentlemen's mansions, houses, factories, store and warehouses, and consequently preserving them from destruction, and preventing the loss of life.*"—Dec. 21.

George Palmer Henry, of Peckham. chemist, for "*improvements in apparatus, to be applied to the glass chimneys of gas burners.*"—Dec. 21.

John Cox, of Gougie Mills, Edinburgh, tanner and glue-maker, for "*improved processes of tanning.*"—Dec. 21.

John Oliver York, of Upper Coleshill-street, Eaton-square, engineer, for "*improvements in the construction of railway axes and wheels.*"—Dec. 21.

William Carron, of Birmingham, lathe-maker, for "*improvements in the construction of clogs and pattens.*"—Dec. 21.

William Henry Smith, of Finsbury Chambers, Bloomfield-street, civil engineer, for "*improvements in the construction and manufacture of connectors or fastenings, applicable to garments, and other uses.*"—Dec. 21.

Adolphe Fourment, of Museum-street, engineer, for "*improvements in castors for cabinet furniture, and other purposes.*"—Dec. 21.

Thomas Wright, of Church-lane, Chelsea, Lieutenant in the Royal Navy, and Alexander Bain, of Percival-street, Clerkenwell, mechanist, for "*improvements in applying electricity to control railway engines and carriages, to mark time, to give signals, and print intelligence at distant places.*"—Dec. 21.

Henry Alphonse Bonnevialle Bouveiron, of Trevor-square, merchant, for "*improvements in axletrees.*"—Dec. 21. (A communication.)

William Burge, of Bristol, sign painter, for "*improvements in propelling vessels.*"—Dec. 21.

William Carr Thornton, of Cleckheaton, machine-maker, for "*improvements in machinery or apparatus for making cards for carding cotton and other fibrous substances.*—Dec. 21.

John Watson, of Chorley, Lancaster, Gent., for "*improvements in the construction of filters, used in the manufacture of sugar.*"—Dec. 23.

William Baillien, of Gloucester-street, Queen-square, Bloomsbury, musician, for "*improvements in apparatus to expand the human chest.*"—Dec. 23.

TO CORRESPONDENTS.

On account of the Index, &c., being more than usually heavy, this month, we have been obliged to postpone some valuable communications, particularly one on Egyptian architecture, and also the important evidence respecting the explosion of a boiler at Manchester.

Communications from "Seyton" *and others must stand over.*

"A Civil Engineer." *Several designs have been submitted to the Corporation of the City of London, for the improvement of Holborn Hill.*

"B." *must, upon consideration, see that we cannot insert his communication, for our Journal might be filled with similar announcements.*

All controversial articles must be subject to our cutting them as short as possible, for we do not wish to extend discussions unnecessarily; too often they contain a great deal of acrimony.

"A." *His communication wants revising; will he do us the favour to say where it can be sent for correction.*

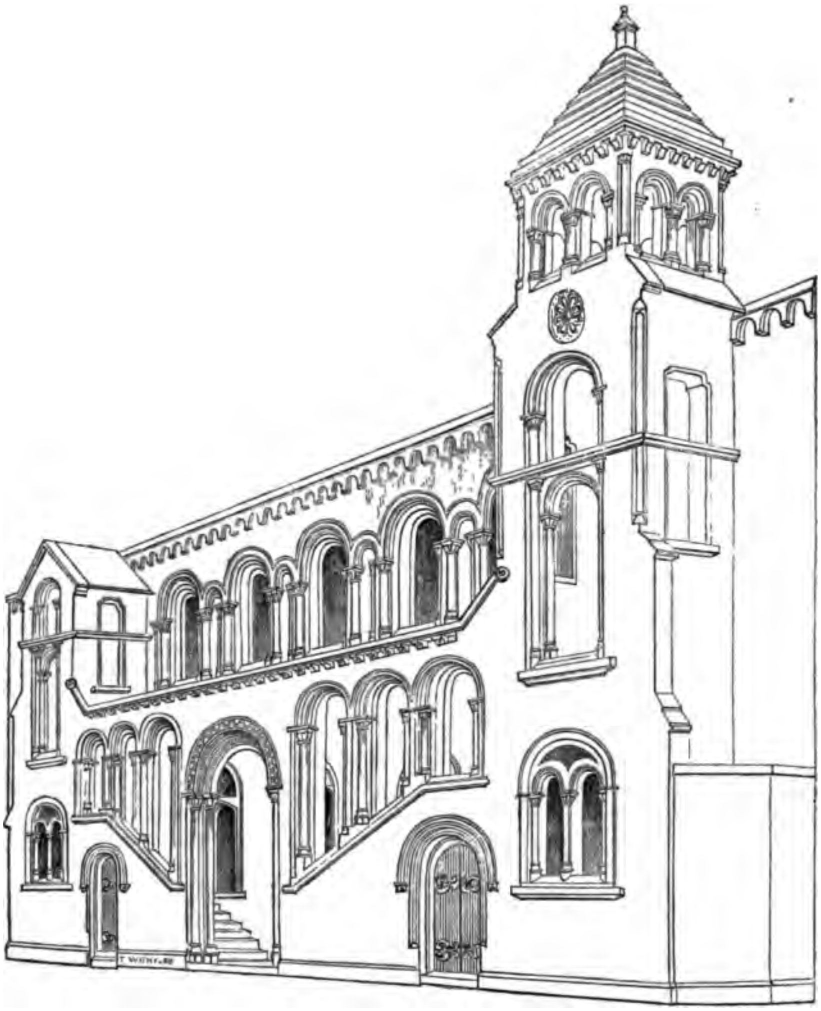
Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," *No.* 11, *Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, III, and IV, may be had, bound in cloth, price £1 each Volume.

THE NATIONAL SCOTCH CHURCH,

CROWN COURT, BOW STREET.



The taste and feeling which a professor of architecture brings to the practice of his art, may be evinced not alone by his style of erecting new buildings, but in a scarcely inferior degree by a judicious alteration of old ones, and though it is not our practice to notice these latter, we think ourselves justified in departing from it, in the instance of the Scotch National Church exhibited in the annexed wood engraving, which has lately been remodelled by Mr. Robert Wallace.

This structure, being under every disadvantage of situation, is likely to be seen by few; having its "locus" in a retired spot called "Crown Court," which forms a connecting link or thoroughfare between Bow Street, Covent Garden, and Little Russell Street.

Though far from being an erection of yesterday, the claims of the original building do not reach to *antiquity;* it would appear in fact, to have been erected something like a century ago, when Presbyterianism and plainness were held to be synonymous, and when the "Scots' Kirk," notwithstanding its *national* character, and the legislative sanctions under which it exists in the sister kingdom, ranked only in the public mind as a variety of the Methodist or dissenting chapel. The conventicle or sectarian character was, up to September last, broadly impressed upon it. Its plain brick front, extending to 60 feet, was pierced in the upper part by a range of 7 semi-circular headed sash windows, between which and the lower openings, consisting of 5 windows with outside shutters, and 2 wood door pieces, with fanlights; over, was a considerable space (10 ft.) of plain brickwork, occasioned by the steep rise of the gallery within. The projection of the porches was about 3½ feet, leaving an unoccupied space or area intermediately, and at the ends, enclosed by an iron railing. With these elements for the architect to deal with, and with the desiderata impressed upon him, 1st, of imparting to the building an ecclesiastical character, and 2nd, of obtaining an external access to the galleries, without injury to the existing lights, he has produced the façade represented in our engraving, the round-headed windows which prevailed throughout the upper story of the building, having suggested the Norman style. It may help to explain the diagram to observe, that the large open arch in the centre of the front gives access to the new external stone stairs, which ascend to the right and left (passing over the heads of the two ground floor entrances) between the pierced screen and the main wall: that the two higher features which break and give variety to the line of front, result from the necessity of forming a headway to the staircases, continued up in them, and entering to the highest level of the gallery, below the sills of the two extreme windows, which receive their light from the front and lateral openings in the towers which mask them in the view. It may further be observed that all the apertures in the new front are open or unglazed (except the two lowest ones in the turrets) in order not to impede the light to the old ones in the main fabric, all of which retain their old forms and positions.

The principal alteration in the interior, consisting of a large semi-circular arch behind the pulpit, embracing in its intrados two smaller ones glazed heraldically, is in correspondence with the exterior, while the pulpit, gallery front, and fittings, it was thought justifiable to render into the Tudor taste.

ON REVERSING ENGINES.

Fig. 1.—Section of Smoke-box.

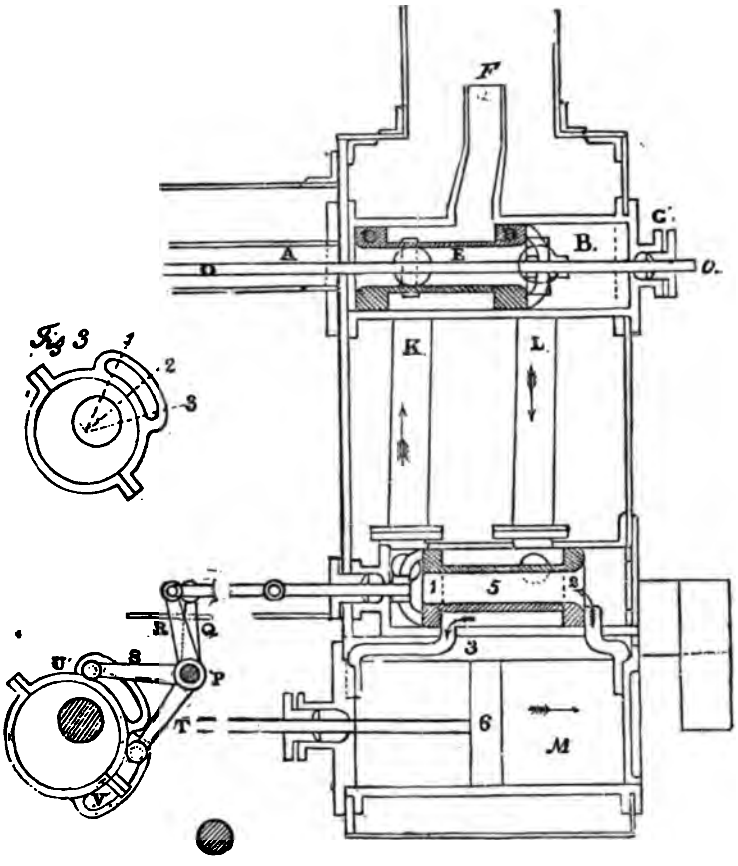
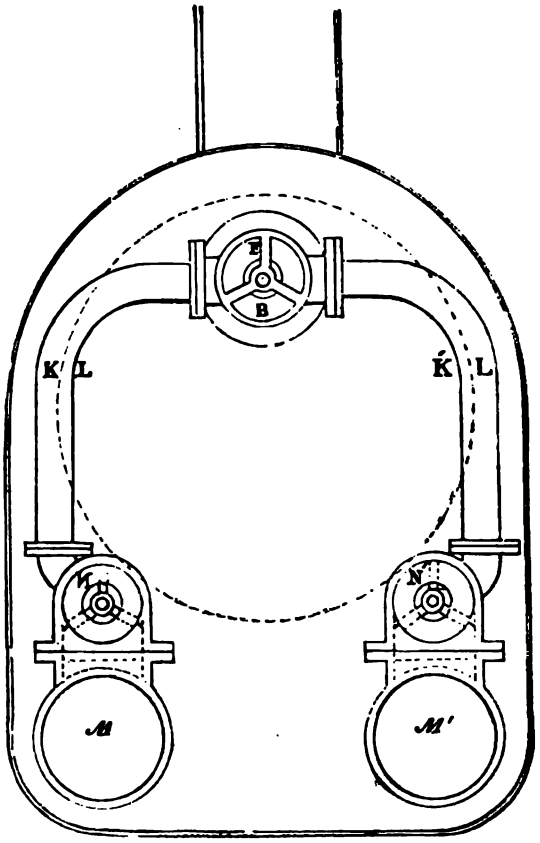


Fig. 2.—Transverse View of Smoke-box.



Sir—As we have seen in your pages a plan of reversing engines, signed G. Coe, civil engineer, which is in principle similar to ours, of which we have been constructing a small sectional model for a locomotive engine, we take the liberty of sending you a small sketch of it, with the request, if you think it worth your attention, to give a place in your Journal. Figs. 1 and 2, show only those parts of a locomotive engine, which are wanted for the explanation of our new improvement.

A is the steam-pipe which carries the steam into a cylinder B, fixed in the smoke-box. In the cylinder B, of about 8 inches inside diameter, move 2 pistons C and D, connected by a pipe E, which can be cast between the pistons, as the distance between C and D must be always the same. The piston rod is connected with the pistons by means of a boss fixed to D, by 3 stays, and is guided in the stuffing boxes G and H. On the top of the cylinder B, is the exhausting pipe F, on its sides are short pipes K K' and L L', which have a section of 5in. by 1¼in., where they enter the cylinder, and a round section on the other end.

The steam cylinders M M', have instead of valve boxes, cylinders N and N', with pistons 1 and 2, similar to those in the cylinder B, and those cylinders N and N' are connected with B by means of the pipes K K' and L L. The pistons 1 and 2 will act exactly like a common valve in respect to shutting and opening the steam passages 3 and 4 of the steam cylinders M M', as they are moved by a common eccentric, (keyed to the crank shaft) by means of the levers R S and Q F.

As we have given now all the explanation of the different parts shown in the sketch, we will next explain how we start, reverse, and stop the engine, without disengaging the spindles of the pistons 1 and 2, from their eccentric rings.

Suppose the engine is to start in the direction shown by the arrow the stand of the pistons C D in the cylinder B, would be as the sketch shows it. The steam will pass through the pipe E, go through the pipes L L, down to the cylinders N N', round the pipe 5 through the passage 3, into the steam cylinder, and drive the piston in the direction of the arrow; the steam on the other side of the piston will pass through the passage to the pipe 5, up through K K', and enter the cylinder B, from where it can freely exhaust by the pipe F. If it is wanted to stop the engine, the rod O is moved, by means of a lever or a handle with a screw above the fire-box, towards B, till the pistons cover the pipes L L', in that case the pipes K and K' will still allow the steam to pass round the pipe E, into the pipe F, and as there is not any more steam entering the steam cylinders, the engine will stop. It is clearly to be seen that the engineer has it quite in his power to change the areas of the pipes L L', by moving the pistons backwards or forwards, without altering the areas of the pipes K K'.

To show now the reversing of the engine, the rod O is moved in the direction towards B, so that the piston D' opens the communication between the pipes L L' and the exhausting pipe F; and by this the pipes K K' will come in communication with the steam pipe A. The steam will pass through K K', the pipe 5, and the passage from 2 into the steam cylinder, and force the piston 6 in the reverse way; the steam from the other side of the piston passes through the passage 3, round the pipe 5, up through the pipes L L', and out in the exhausting pipe F.

After this explanation it will be seen that by moving our apparatus for moving the engine, a regulator is not required.

We have now to describe how to get lead.

There is only one broad eccentric keyed to the crank shaft, with two eccentric rings, each having a circular slot, which is shown in fig. 3.

Suppose now the pin of the lever S (moving the piston rod *w*, by means of the lever R on the shaft P), stands in the point 2, then the engine would have no lead, but as the friction between the eccentric and its ring, wants to take the ring with the eccentric, it will go round with it till the pin of the lever S has come in the point 1, when it will have the position wanted for the lead. When the engine is reversed the eccentric ring will turn with the eccentric till the pin of the lever S has arrived in the point 3, which will then give the position required for the lead of the reverse of the engine. The eccentric line 2 of the circular slot of the other eccentric ring for the adjoining machine, stands in an angle of 90 degrees to the centre line of the circular slot of the other eccentric ring, through which the lever T and Q, works the piston rod of the adjoining machine.

The levers R and S, and T and Q, can work on a fixed shaft P, by means of loose bushes, or the shaft P has to be divided in two, and then the levers can be keyed or forged on the shaft.

We are, Sir,
Your obedient servants,
H. and P.

15, *Bedford Street,*
Chorlton-upon-Shedlock, Manchester.

BRAITHWAITE'S APPARATUS FOR DISCONNECTING THE PADDLE WHEEL OF STEAM VESSELS FROM THE ENGINE.

Fig. 1.—Side view.

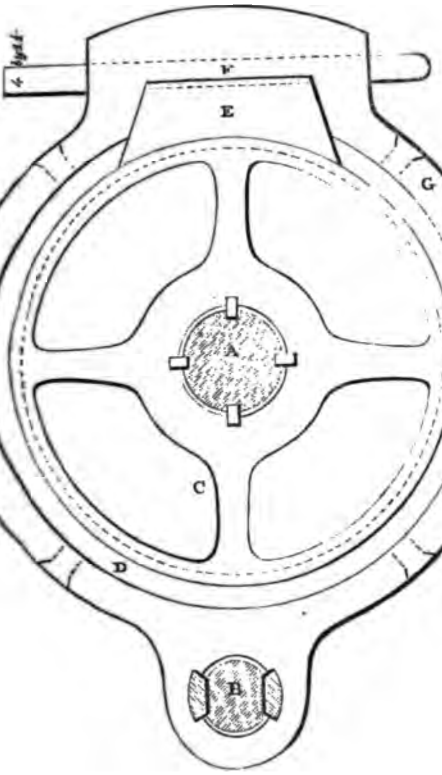
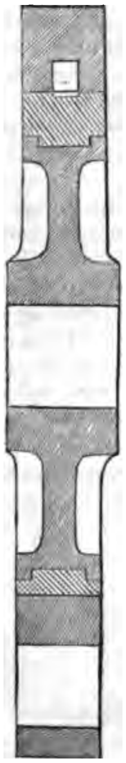


Fig. 2.—Section.



In our last number we gave a description of an apparatus for connecting and disconnecting the paddle wheels of marine engines. We have now another apparatus to describe, which appears equally as effective, and very simple in its action. It has lately been tried at Woolwich, on board H. M. steam vessel "Kite," and found to answer the purposes intended; it is the invention of Messrs. Braithwaite, Milner & Co., of the New Road. The annexed drawings and description fully explain its action.

A, Paddle wheel shaft.
B, Crank pin.
C, Cast iron disc keyed to shaft.
D, Brass friction band fixed by screws to the external wrought iron rim G.
E, Brass friction break.
F, Iron key wedge, head, 4"×1½".
G, External rim, 2½"×6" of cast iron keyed to crank pin.

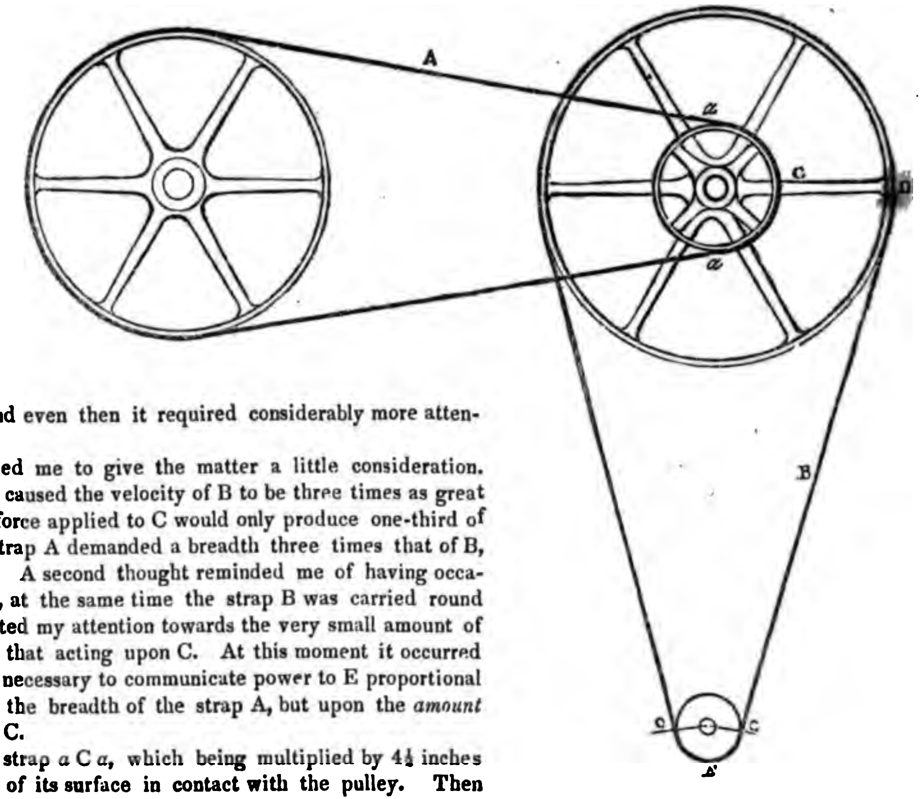
For the purpose of disconnecting the crank, it is only necessary to drive out the key, which immediately relieves the brass break E from pressing against the cast iron disc, and allows either the external rim and the crank or the internal disc and shaft to revolve independently of each other.

For the purpose of connecting the apparatus, it is only requisite to drive in the keyed wedge, which forces the brass break E against the iron disc.

ON THE PROPORTIONS OF STRAPS FOR DRIVING MACHINERY.

Sir—Although the subject of the present communication may, to some of your readers, appear of a nature too frivolous, or not altogether adapted to the character of your journal, it is still a subject of the most frequent occurrence to the practical mechanic, and probably that which receives the least of his attention. However, I cannot recollect ever seeing in print any rule or proportion relative to the breadths of straps for driving. Probably this is owing to the great variety of circumstances to which straps are subject, and which differ more or less in almost every case; such for instance as horizontal, vertical, long, short, open, and crossed straps, the pliability of the leather, and so on. A horizontal strap is better than a short one, and a long horizontal strap will always perform its work with much greater ease than a short one. A crossed strap, whether horizonta or vertical, is known to be more powerful than an open one, &c. But I will not pretend to give any rule for determining the power of a strap; the object of this communication is, to direct your attention to a *combination* of straps.

In a combination, that is, a number of straps one working another over drums and pulleys for multiplying the number of revolutions, it is very common for one or two of the straps to be constantly breaking or giving way, while the others work for months and months without requiring the least repair. The straps which most frequently get out of repair are generally those which travel at the greatest velocity, and it is to the rapidity of their motion that their frequent breaking, &c., is generally attributed: but I am inclined to think that this is not the real cause, in proof of which I will here give an instance of a very recent occurrence that came under my notice.



The annexed sketch shows the arrangement of the drums, straps, &c. The strap A was 4½ inches broad, B, on account of its greater velocity, was at first made only 2 inches broad, but when it came to be tried the consequence was, its not being able to drive the machine without being so tight as to be constantly breaking, wherefore it was replaced by one an inch broader; this too was far from performing its work in a satisfactory manner. Although this strap was two-thirds as broad as the driving strap A, and travelled at a velocity three times as great, it was still found necessary to increase its breadth to 4 inches, and even then it required considerably more attention to prevent it from slipping than A.

The peculiarity of this circumstance induced me to give the matter a little consideration. The proportions of the pulleys were such as caused the velocity of B to be three times as great as that of A; this informed me that a given force applied to C would only produce one-third of its effect at D, and consequently, that the strap A demanded a breadth three times that of B, which I knew not to be the case in practice. A second thought reminded me of having occasionally observed the pulley E perfectly still, at the same time the strap B was carried round with the drum D at full velocity. This pointed my attention towards the very small amount of strap-surface acting upon E, compared with that acting upon C. At this moment it occurred to my mind, that the breadth for the strap B, necessary to communicate power to E proportional to that possessed by C, depended *not* upon the breadth of the strap A, but upon the *amount of its surface acting upon the circumference of* C.

I next proceeded to ascertain the length of strap *a* C *a*, which being multiplied by 4½ inches (its breadth), gave 121·5 inches, the amount of its surface in contact with the pulley. Then as 1 (the velocity of A) : 121·5 : : 3 (the velocity of B) : 40·5 the amount of surface required to act upon E. Now 40·5 ÷ 8 inches (length of strap acting at *c* E *c*) = 5· &c. I was then clearly convinced that the strap B, which had been increased from 2 to 4 inches broad, demanded a breadth of 5 inches to render it capable of producing an effect upon E proportional to that produced by A upon C.

In some instances straps thus proportionate may require to be of an unsightly breadth, but then is it not evident that in such cases, the first determined strap is broader than necessary? However, I am of opinion that in many cases of ordinary occurrence, the broad straps are more suitable to occupy the situations of the narrow ones, and *vice versâ*. In conclusion, I trust, supposing what I have here said to be successful in conveying my meaning, that those whose curiosity may lead them to give the subject a little consideration, will with myself agree, that the breadths of straps in a combination *ought not*, as cog wheels, to be proportionate to their velocity; but that their breadths are dependent on the *amount of their surface acting upon the smaller pulleys*, in proportion inversely to their velocities.

I am, Sir, in every respect,
Your humble servant,
Vesper.

Leeds, January 11, 1842.

ON ARCHITECTURAL PRECEDENT. (TO H. S.)

The remarks on architectural precedent by H. S. were particularly pertinent, and would have been perfectly clear, had the concluding paragraph been omitted; but the opinion there expressed is very far from self-evident, and will certainly require further explanation. Our endeavours should always be to surpass our predecessors in the scale of excellence, not by undervaluing them, while we remain stationary, to prove that they are inferior to ourselves; and something more is surely required than a neat antithesis, to depreciate the character of a people whose works, whether of art or literature, have been the delight of men of taste for more than 2,000 years.

The system of classical education 50 years ago might well keep up the prejudice against Gothic architecture; but that is now in a great measure done away, and the evil of architectural precedents is as great as ever, and influences Gothic quite as much as Grecian. There must therefore be some other cause for the evil than that cited by H. S.

Every ancient building is useful in the education of an architect, as exhibiting what has been produced by the genius of our predecessors, and what method of proceeding circumstances have induced them to adopt. Grecian architecture affords specimens of carefully-studied and accurately-beautiful proportions; the grandeur produced by simplicity of plan and construction, and the careful treatment of detail: and the excellence of their sculpture, which no one has ever questioned, indicating a superiority in one branch of art, demands from us a more careful examination of their architecture than a superficial view might first appear to render necessary. Roman exhibits the effect of magnitude, combined with greater multiplicity of parts, increased complexity of plan, and skill in construction. In Gothic we see a rather less complicated plan—the extreme of constructive skill—and a grandeur of effect united with a richness and delicacy of detail combining in this respect the excellencies of the Greeks and Romans. In the same manner something may be learned from every style, Egyptian, Indian, Mahometan, &c. From these studies the architect discovers the principles of taste, and the power of criticising not only the works of others, but what is more difficult, his own. At the same time that he is profiting by their experience he must exercise his invention by constant practise, and he need not fear the greatest exuberance of fancy, if restrained by good taste, being only dangerous where it obtains the mastery over judgment. Beyond this, as materials, which are the common property of every body to cut and remodel, or copy with such variations only as indicate that while we assume the manner we entirely disregard the spirit, they are absolutely worse than useless. This, however, is the abuse, and should not discourage a judicious use of them.

J. L.

DITTO TO H. S.

Sir—Of the "Hints on Architectural Criticism," I say nothing, they being to me as mysterious as Lord Burleigh's shake of his head, and no doubt equally significant, although few, I suspect, can comprehend the writer's meaning and "attitude." But the paper of your Derby correspondent, H. S., has afforded me very great satisfaction; for, as far as it goes, it is exceedingly sensible, and very much to the purpose. Without at all undervaluing the merits of classical architecture, without depreciating it in itself, it is time for us to get rid of that extravagant pedantry and that bigoted reverence for it, which are for the most part no better than cant. And it is owing to this cant, by the bye, that the belief in the vast superiority of the ancient orders is "so universal," such belief being adopted ready-made, without inquiry or investigation, and consisting of little more than "raptures learnt by rote."

Were it found that ancient architecture accommodates itself perfectly to, and is all-sufficient for, our purposes at the present day, there might be something like reason in deprecating any departure from its precedents. Such, however, is by no means the case; on the contrary, it inevitably becomes more or less changed in its character—in some instances, has been most of all metamorphosed by those who affect the greatest veneration for it. It is, therefore, quite absurd to lay so much stress as is done on the mere copying by routine a few details, when, after all, the aggregate effect—the *ensemble*—must be totally unlike that of the structures from which some of the individual parts are mechanically borrowed. Surely, if an architect does not scruple to *innovate* so largely as to introduce windows within porticos, or between Grecian columns,—if he does not consider features of that kind as at all foreign to classical architecture, or as derogatory from its so greatly-extolled simplicity and purity,—it is most contemptible affectation, or something still worse, to insist upon, and even make a merit of, strictly copying the mere conventional embellishments of the order itself that happens to be employed, and which is for the most part dragged in, sometimes with, but oftener without, any appearance of utility or propriety. In fact, such pretended veneration for the models of antiquity is seldom little better than a plausible excuse for not bestowing any study on, or attempting any originality in regard to the character of an *order*—even such modification as would render it more of a piece with the rest; whereas, as now treated, the classical order chiefly serves to show how very unclassical the structure itself is. In fact, it is only cant on the one hand, and custom on the other, which reconcile us to the practice of *hashing-up* Grecian architecture after the fashion we do, sticking the columns borrowed from some antique example before a building full of windows, the latter being, perhaps, only so many holes in the wall. Except that custom is not in its favour, it would not be a whit more preposterous to introduce pointed windows of rich design into an otherwise perfectly plain front, and pass it off as a specimen of the Gothic style.

Under the plausible pretext of reverential respect for the precedents of antiquity, its ultra admirers would limit us at the present day to "servile copyism," although necessarily imperfect in itself; and strenuously set their faces against, and deride, even beforehand, any attempt to originate novelty in architectural detail. Most triumphantly do they refer to previous failures, although the last in fact prove nothing, except that those who made the unlucky experiments were in every respect unfitted for the task they assumed, since they plainly showed themselves to have no principle of taste in common with that of the ancients. To enlarge upon the present system of the orders requires a taste *well-nourished* by previous study of them, and not, as seems to be assumed, mere fanciful caprice and whim. Either architecture is not a fine art at all, or it admits of originality and invention—guided, be it understood, by judgment and good taste. It most assuredly does not follow, that every one is capable of displaying those qualities; yet, though it may be advisable for the many to adhere with exactness to established precedents, as being by far their safer course, that is no reason whatever why all without distinction should be interdicted from exercising their originality; nor is it in accordance with common sense, that no liberty of invention should be allowed, merely because, in aiming at originality, some have run into the most puerile and tasteless extravagances. Emancipating himself from precedent, Emlyn invented "a new order," and one so preposterously absurd and tasteless, that it has deservedly covered his name with ridicule. What then? Schinkel, also, emancipating himself from precedent, produced several novel designs for capitals, exhibiting the most refined and exquisite taste. "But," exclaim the bigots, "we do not want new capitals or new orders; the old ones are quite sufficient for our purpose:" which is but a very sorry kind of argument in matters of art. They assure us, moreover, that it is impossible for us to improve upon the ancient orders, or to produce anything new that shall rival them. Yet this is but silly and evasive reasoning; they might as well tell us that St. Paul's was intended as an improvement upon the Parthenon, and is consequently a decided failure. If originality can produce what is good in itself, it is not to be condemned because it may happen to fall short of foregone excellence.

Ditto.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXXIV.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. We have had both Rejected Addresses, and Rejected Articles, and why not Rejected Designs? Were some productions of the latter kind published, they would assuredly be of service, either one way or other; either by reconciling us to those which have been preferred to them, and carried into execution, or by showing what sort of taste and judgment it is that generally decides in such matters. That the best design offered is invariably the one selected, is what people in general may suppose, it being according to common sense that such should be the case; but it is what no one who is in the slightest degree conversant with such transactions will for a moment believe. We have seen rejected designs, which have been in every respect greatly superior to the one that has been adopted, and which could have been executed for the same sum, if not even for less. Greatly, therefore, is it to be desired, that some "*contrasts*" of the kind should be published, in order to let people see how much better things they might have had than what they have now got, and what kind of wiseacres they are whom they suffer to choose for them. In one point of view, such contrasts would be amusing enough, yet in another they would be sadly mortifying; still, the very mortification itself might have salutary consequences, by teaching greater caution for the future, and making Competition Committees more careful and scrupulous, from the dread of ultimately committing themselves.

II. Mr. Thomas Roscoe shows himself to be either the most mendacious or most ignorant of writers, when he assures us that Burgos cathedral bears a striking resemblance to that of York. "Its steeples," he says, "terminating in spires, and vast square towers with eight pinnacles, correspond *exactly* with those of the English church; and to complete the likeness, we have a lower octagonal building with eight pyramidal turrets, terminating in needles, piercing a star-like ornament, which the reader will at once recognize as the counterpart of the Chapter-house at York." Mr. Roscoe's readers may, perhaps, be capable of swallowing anything; yet, doubtless, some even of them must have been startled—at least strangely puzzled and perplexed—

on comparing that description with the accompanying views by Roberts, to which it was intended as explanatory; for if they know anything at all of the English cathedral, they must have wondered how any one can trace any sort of resemblance between the two edifices, or between their respective Chapter-houses. Whether Roscoe had unfortunately got hold of a print of York Cathedral at the time, supposing it to be the representation of that of Burgos, I know not; but nothing short of some strange mistake of the kind can account for his blundering remarks. It is true, both Burgos and York have two western towers, yet so also has St. Paul's; and therefore, at least as far as the façade is concerned, he might as well have compared it with that of the last-mentioned structure. The exact similarity which Roscoe is lucky enough to be able to perceive between Burgos and York, is *exactly* like that which exists between a dog and a cat, both of them being animals with four legs and a tail; and no doubt he would have pointed out that remarkable coincidence, had he been writing a book of natural history. The west front of Burgos has two very rich spires of open-work tracery, and is otherwise of peculiar design, while York has nothing whatever of the kind. The centre compartment of the first shows no gable, but terminates in a horizontal deep parapet of open arches, &c., with a canopied niche in its centre: the other, on the contrary, has an embattled gable or pediment, covered with tracery. At Burgos, this portion of the front is divided into two tiers of windows, viz. a large rose window below, and two arched ones above it; whereas, at York it has a single large window, gabled and embattled, and remarkable for the pattern of its tracery. In fact, there is no sort of resemblance between the two structures; since whatever they have in common constitutes also a decided difference. It may perhaps be some little excuse for Roscoe, that his Spanish excursion was merely an invention, and that he travelled no further than to the British Museum; whereas, if he really did visit Burgos and the other places he mentions, he must have forgotten to take his eyes with him.

III. A plague upon all description-mongers of the Roscoe, Ritchie, Gore, and Co. genus!—people who only blunder and bungle most dreadfully, when they attempt to speak of buildings, and who, to give them their due, *shirk* saying anything about them at all, if they can possibly avoid it, and find any other filling-up stuff, no matter what, so that it does but eke out the quantum of pages, which is all many publishers care for, or indeed, the "intelligent public" also. The letterpress to Pugin's Paris is a precious specimen of this sort of description; done, it would seem, by one of the publisher's shopmen or porters. The blunders and proofs of ignorance are innumerable; and no wonder, when the writer does not even know the difference between a portico and a portal. Nevertheless he has shown some contrivance, in contriving to give *descriptions* of plates, without saying a word relative to their subjects. Such is the case, for instance, in regard to the view of the staircase of the Chambre de Paris, where not the slightest information of any kind is afforded—not even so much as a syllable.

IV. Pedantry, I am happy to say, seems to be far less rife among the juniors of the profession, the rising generation of architects, than it has been among their predecessors. They seem to be imbued with more artist-like feeling, and willing to shake off the trammels of rules in themselves merely conventional, and little better than hindrances and obstacles, when allowed to interfere with æsthetic principles. Probably Professor Hosking has contributed in no small degree towards this very desirable liberalism in architectural taste, by the remarks contained in his "Treatise," and by the courage he showed in venturing to impugn the authority of Vitruvius, whose writings may certainly now be dispensed with, or retained only for their philological value, since we have now become far better acquainted with ancient architecture from actual examples of it, and carefully-drawn delineations of them, than it was possible to be at the time so much importance was attached to the work of Vitruvius. The study of those examples has further tended to show how imperfectly Vitruvius understood his own art, and to what a plodding mechanical system he endeavoured to reduce it. Though he indulges in a great deal of idle pompous verbosity and twaddle,—pretty much as if he was an F.S.A.,—on no occasion does he make a single remark in the spirit of an artist, or say anything that in the slightest degree amounts to criticism. Of principles he seems to have no idea; on the contrary, he is deplorably dull himself, and his dullness appears to have been hereditary, and to have ever since infected the greater portion of writings upon architecture since his time. It is perhaps—or for "perhaps" I should be inclined to say it is "undoubtedly"—to be regretted that his writings were ever discovered, since they have exerted a most unhappy influence on the art, checking it in the very bud, when it would else have expanded itself, if somewhat more slowly, with greater freedom and geniality. But for that unlucky discovery, architecture would probably never have fallen into the hands of order-mongers, but have been left to develop its powers without artificial restraint, as was the case with the Gothic style.

ROBERT STEPHENSON'S NEW LOCOMOTIVE.

With the progress of the locomotive engine, it has, like other machines of extensive use, attained that period when its economy becomes of the greatest importance. Influenced by such considerations, Mr. Robert Stephenson has directed his attention to a less consumption of fuel, and to effecting a more simple arrangement of the machinery, both of which points have been well managed in his new engine now running on the York and North Midland Railway.

Economy in the consumption of fuel has been obtained, by adding considerably to the length of the tubes, without increasing the distance between the front and back axles of the engine; consequently the space occupied by the engine upon the bearing is precisely the same, therefore no alterations are requisite in the turn-plates, or other arrangements made for the accommodation of the ordinary locomotive. The machinery is simplified by placing the axles of all the wheels under the cylindrical portion of the boiler, the axle of the front wheels being placed close to the smoke box, and the axles of the hind wheels close to the foremost end of the fire box, instead of the back part. This arrangement allows the axle of the driving wheels to be placed in the centre of the other two axles, or at such intermediate distance as may be found the most suitable for the moving parts.

The alteration in the construction of the boiler and tubing gives a heating surface of 800 superficial feet, whereas in the ordinary engine it rarely exceeds 450 feet, being for the new plan a superiority of fully 350 feet. Such is the effect produced by this addition, that the temperature of the air escaping in the chimney scarcely exceeds the temperature of the water in the boiler; a circumstance which has a farther beneficial effect beyond the economy of fuel, for it has been found, by increasing the extent of heating surface, and employing usefully the whole of the heat generated in the fire, that a less violent draught of air is required; the consequence is that very few hot ashes are thrown out of the chimney; this peculiarity is quite remarkable in the engine now running. A few days since, a journey of 90 miles was performed by this engine, during which no ashes were thrown out of the top of the chimney, and at the same time the accumulation in the smoke box was very trifling, not exceeding a fourth of the usual quantity. As the tendency to eject ashes from the chimney is dependent upon the speed, it is necessary to state, that the speed was never below 20 miles per hour, generally exceeded 30, and for several miles a speed of 48 miles per hour was uniformly attained, with five loaded coaches.

The consumption of fuel during the above experiment was 19·2 lb. per mile, with a load of 8 coaches over half the distance (45 miles), and 5 coaches over the remaining half. This consumption includes the whole of the fuel used in lighting the fire and raising the steam.

We may truly say, that we have never witnessed an instance where speed and economy were combined to the same extent; indeed, under no circumstances have we heard of the consumption of fuel being reduced to so low a figure. It must, however, be borne in mind, that this result is from a single experiment, and that we must not be deluded by isolated trials; but we are glad to hear that on the line where the engine is now working, the Company have ordered an accurate record of the performance, and quantity of fuel consumed during each trip, which we hope will be made public.

Mr. Stephenson has introduced tubes of wrought iron, instead of brass or copper, in order that the increased heating surface might be obtained without a corresponding augmentation in the price of the engine. This he has not adopted without making several experiments. During the last twelve months, he has had several boilers working under his own eye with iron tubes, for the special purpose of determining how far he could recommend them for general adoption. The result has been all that he could desire; and it is owing in some degree to this, that he has introduced them with greater confidence.

Having now described the modification in the boiler, we shall proceed to point out Mr. Stephenson's alterations in the mechanical arrangement. In the ordinary engines, the mechanism for working the slide valves is very liable to derangement, and considerable wear and tear. This part of the engine he has so far simplified, as to require only a simple connexion between the eccentrics and slide valves, thus doing away with a considerable number of moving parts, which have hitherto given rise to more casualties than any other part of the ordinary engine. This is attained, by placing the slide valves vertically on the sides of the cylinders, instead of on the top, as heretofore, so that the direction of the sliding motion of the valves, and the central line of the valve rods, will intersect the central line of the main axle, at the point where the eccentric is placed. In this case, the eccentric rods are connected immediately to the prolongation of the valve rods, without the usual intermediate levers and weigh bars; besides the slide valves of both cylinders are placed in one steam chest, between the cylinders.

Another improvement is that effected in the working of the feed pumps: it consists in connecting the pump rods to the eccentrics used for reversing the engine. By this arrangement, the velocity of the moving part of the pump is greatly diminished, by which is secured greater regularity of action. In addition to what we have already described, there are several minor alterations, which we cannot fully explain without giving detailed and elaborate drawings.

The following are the principal dimensions of the engine now working on the York and North Midland Railway:—

Diameter of cylinder	14 inches.
Length of stroke	20
Diameter of driving wheels	5½ feet.
Ditto of small ditto	3
There are 150 tubes, giving a heating surface of	765
Copper fire box, with a heating surface of . .	30
Total heating surface	795 feet.
Length of boiler, including fire and smoke boxes .	17 feet.
Weight of the engine in working order . .	15 tons.

ON THE ORIGIN AND HISTORY OF THE OBLIQUE ARCH WITH SPIRAL JOINTS, AND THE VARIOUS SUBSTITUTES FOR IT.

Mr. Editor—The interest taken by you in this subject is fully evinced by your inserting in your journal of 1840 several papers by the following authors: Edward Parry, C.E., Edinburgh; B. H. B., Edinburgh; G. W. Buck, W. H. Barlow, Peter Nicholson; and in 1841 by W. H. Barlow, Peter Nicholson, and G. W., York; I therefore trust you will find me a corner, being an original subscriber to your very valuable journal, for some observations on the same subject.

The following are the writers on the oblique arch in the order of date:—

Rees' Cyclopædia, title, Oblique Arch, by William Chapman, C.E.; Encyclopædia Britannica, On the Oblique Arch, by Thomas Tredgold; Treatise on Masonry and Stone-cutting, 1828, by Peter Nicholson; Paper read before Literary, Scientific, and Mechanical Institution of Newcastle, June, 1833, James Losh, Esq., Recorder of Newcastle, in the Chair, On the Origin and Progress of Architecture, and of the Arch in particular, and especially to show that W. Chapman was the inventor of the Oblique Arch—by Henry Glynn, Newcastle; London and Edinburgh Philosophical Journal, a paper on the construction of Skew Arches, by Charles Fox, April, 1836; ditto, March, 1837; London and Edinburgh Philosophical Journal, A Letter from Henry Welch, Newcastle, to Peter Nicholson, March, 1837; Society of Arts, Edinburgh, A Paper by Edward Sang, C.E., on Oblique Arches, read Nov. Dec., 1835, Jan. 1836, and May, 1838; Treatise on the construction of Oblique Arches, by James Hart, Mason, Weale, 1837; Essay on Oblique Bridges, by George Watson Buck, July, 1839; Treatise on the Oblique Arch, by Peter Nicholson, published in parts, part 1 published Jan., and part 2 in May, 1839.

The following are the facts, as brought forward in the paper of Henry Glynn, claiming the honour of the invention for Mr. W. Chapman. In the article in Rees' Cyclopædia, Mr. Chapman says "It occurred to him" that each course of *voussoirs* should be rectangular to the face of the arch, and their beds spiral, and their soffits curved in that direction, and twisted in their sommering, and that the head of each *voussoir* in the acute angle of the bridge would make an obtuse angle with its soffit decreasing towards the brim, whence it becomes acute, and increasing as it approaches the other abutment. The beds of the *voussoirs* are also twisted, and under equal widths of bed, the space between the intrado and extrado are increased upon the face, as the haunches are approached (in the proportion as the secant of their angle of deviation from a rectangle, with a line drawn between each extremity of their soffit). The joint at the centre of the arch is only rectangular from the face, the others diverging towards the obtuse abutment, and increasing as the haunches are approached, and converging towards the obtuse abutment. The development of the face line of arch convex where acute with abutment, and concave with the obtuse abutment. This curve he calls Polygonic, and the convexity will depend upon the versed sine of the arch, and that the form of arch to be preferred is the flat segment; that the head of each *voussoir* on the acute angle makes an obtuse angle with its soffit, decreasing as the crown is approached, thenceforward becoming acute, and increasing as they approach the obtuse abutment. Finlay Bridge near the town of Naas, over the Kildare Canal, a branch from the Grand Canal, was erected by him in the year 1787, on the above principles. It is 25 feet span, with a rise of 5½ feet, and the obliquity is 51°, or its supplement 39°. Mr. Chapman says "since the above period the plan in a few instances has been followed; the same idea may have occurred to others, although he never heard of it." Mr. C. was a native of Whitby, Yorkshire, and practised extensively as an engineer in Ireland, and died at Newcastle-on-Tyne, 1832. He was a member of the Royal Irish Academy, and of the Institute of Civil Engineers, London. In the works of the writers on this subject since Chapman's time, no new principle has been developed, but only more improved modes of working the arch stones; and none of the writers notice Chapman, except Peter Nicholson, who tamely says, "He seems entitled to the honour of originating the idea of oblique bridges in their present form, but he does not appear to have laid down any sound principle by which it might be done;" and even this brief notice is suppressed in the second edition, and in many copies of the first of Peter Nicholson's work.

Previous to Chapman's bridge, all bridges of this description had been built with the *voussoirs* laid parallel with the abutments, and their ends bevilled off in the direction of the roadway, and had been carried by this means to an obliquity of 15° from a right angle; and for others, where the obliquity was greater, the arch was turned square, and the parapets curved in the direction of the roadway, leaving alternate triangles outside them.

The following bridges have been built on Chapman's principle:—

1 on the High Peak Railway, 1829. Thomas Jackson Woodhouse, Engineer.

1 on the Stockton and Darlington ditto, 1825. John Dixon, Engineer.

1 on the Great North Road, three miles north of Newcastle, on the road to Morpeth.

15 on the Liverpool and Manchester Railway, 1830, of the following spans—14 ft., 15½ ft., 31 ft., 26 ft., two 38 ft., 47 ft., 32½ ft., 34 ft., 33 ft., three 30 ft., 54 ft., and one of two arches, 65 ft. span each. The one 54 ft. span is built at an angle of 56°, or its complement, 34°, at Rainhill, and wholly of ashlar. George Stephenson, Engineer.

1 on Hartlepool Railway, at Castle Eden, 1834.

Several on the York and N. Midland; 1 over the river Aire, 65½ ft. span, at an angle of 60°; 1 over the Calder, of three arches, 50 ft. span, at an angle of 75°; the arches are brick.

9 Newcastle and North Shields, of small spans, 18 ft. each, 1839. Robert Nicholson, Engineer.

Great North of England Railway, bridge over the Tees at Cross, 1839; four arches of 60 ft. span, being segments with a versed sine of 14½ ft., built at an angle of 50°. The height of the bridge is nearly 70 ft. from the water, and measured from out to out of parapet, in the square, is 23 ft. 9 in., whilst, measured in the direction of the abutment, the length is 37½ feet; 19 courses of the arch stones spring from an abutment, and 44 are independent of either, (each stone is 13¼ in. broad on the soffit, 19¾ in. long, and 2½ ft. in depth,) making a mass of stone in each arch, without including the haunches or parapets, of 300 tons weight, suspended in mid air, capable of bearing as many tons more passing over it, at the rate of 30 miles per hour. Truly this is a work of which modern science may be proud. This magnificent work was designed, and superintended during its execution, by Mr. Henry Welch, the surveyor of bridges for the county of Northumberland.

On the Brandling Junction Railway, 1 bridge 38¾ ft. span, with a versed sine of 6 ft., segmental at an angle of 76°, 1839. John Benj. Green, Architect, Newcastle.

1 on Midland Counties Railway, near Sawley, 30 ft. span, built wholly of ashlar, at an angle of 45°. Thomas Jackson Woodhouse, Engineer.

The extraordinary expense in executing the oblique arches, coupled with the risk of insecurity when carried to any large extent, has induced engineers to find some other material than stone, and the following plans have been adopted. In the year 1827, Mr. Leather, of Leeds, constructed a bridge at Monk Bridge, near Leeds, and another in 1833, at Hunslet, near Leeds, both of cast iron, on an ingenious and novel plan, viz. two arches of cast iron, with the roadway suspended below. This principle has been adopted on the London and Birmingham Railway, and the North Midland at Derby. Wooden arches on the laminar principle have been similarly used by J. B. Green, of Newcastle, and framing on the Schaffhausen plan, by Mr. Blackmore, engineer to the Carlisle Railway. Cast iron arches and girders have been extensively used, by building the abutments askew, and placing the girders in the direction of the intended roadway. There is one of cast iron, of 47 ft. span, over the Uppingham Road, on the Midland Counties Railway, Thomas J. Woodhouse, Engineer; one on girders, 37 ft. span, over the Paddington and Grand Junction Canal, on the Great Western Railway, I. K. Brunel, Engineer; on the Manchester and Birmingham Railway, over the Fairfield street, Manchester, G. W. Buck, Engineer; a cast iron arch, of 128¾ ft. span, at an angle of 25°. The abutment is in the line of the street, and the arches placed in the line of the railway, 6 ft. apart, and the stone abutment above the springing line, set back square, with the end of each arch or rib so as to form its abutment on the principle of a common square bridge.

On the Midland Counties Railway, where the Loughborough and Stamford road is carried over the railway, Mr. Woodhouse has erected a bridge wholly of brickwork, on the principle of the iron bridge of Mr. Buck. The ribs of brickwork, if we may use the term, are elliptic, 42½ ft. span, with a versed sine of 11 ft., and are 4 ft. in breadth, measured on the square. The soffit of the arches, or ribs of brick are level or flush, in the direction of the centre of the railway, but are not so in any other direction, dipping below each other in succession, and increasing gradually as the abutments are approached, being greatest at the obtuse end of the abutment. The above is a unique specimen, being the only one ever erected, and is the bold invention of Mr. Woodhouse, and was erected in 1839-40.

I trust that, as the origin of the arch in architecture, as also the time of the introduction of the pointed arch, are both lost in the annals of time, it will be a sufficient ground for your republishing, at full length, the article of Chapman in Rees' Cyclopædia, that the time of the introduction of the oblique arch may be more fully known, and the real inventor have his due meed of praise. This is certainly due to the memory of Chapman, and I trust, from the principles developed in the paper of Henry Glynn, as first promulgated by Chapman, will justify me in coming to the brief conclusion, in respect to the other writers on the subject, that they have developed no new principle, but only improved the mode of working the stones, and perhaps mystified the subject with unnecessary technicalities.

I am, Sir,
Your's obediently,
Oliver Twist.

St. Ann's,
Newcastle-upon-Tyne.

MR. CHARLES WYE WILLIAMS AND HIS BOILER PROJECTS.

Considerable attention has been lately excited by the disquisitions of Mr. Charles Wye Williams, respecting two alleged inventions of his, one of which has for its object the prevention of smoke, and the other the increase of the evaporative rate of boilers, by studding them over with spikes, "like quills upon the fretful porcupine." In the belief that an analysis of these projects will be acceptable to our readers, and may possibly be beneficial to this gentleman himself, we are induced to offer a few observations respecting them.

Let us first anatomize the spike boiler plan. The following account of this notable invention we extract from the 950th number of the Mechanic's Magazine:—

"When the gases which are the products of combustion (and which contain all the heat arising from such combustion) pass along through the flues impinging against the surface of their metallic plates, the heat is conducted in a direction at right angles to these surfaces, to the water in the boiler. This then may be called *transverse* conduction, as the heat passes transversely through those plates. But if we heat one end of a rod of iron, we find a very large conducting power is brought into action, by reason of the heat passing *longitudinally* along its fibres, and with great rapidity. This may, therefore, be called *longitudinal* conduction, in contradistinction to the former *transverse* conduction. Now this is the power, or modification of the power, of metallic conduction, which it is proposed shall be rendered available, and the application of which is at once so practicable and effective.

"Independently of the conducting power which a metallic pin of any size may have, it is manifest that it possesses an absorbing or receiving power, in proportion to its length as well as its diameter, and this it is which gives it an available applicability in the flues of boilers. Suppose an iron or copper pin, of half an inch in diameter, inserted into a metallic plate, and projecting 3 inches beyond its surface. In that case, a portion of such surface plate, equal to a circle of but half an inch in diameter, is occupied, while the pin itself presents a heat-receiving surface equal to 4½ inches, or as 9 to 1. If this projection be presented to the stream of heated gaseous matter in the flue, we obtain an effective heat-receiving surface, nine times greater than the area of the plate which the pin occupies. In other words, the half-inch circular portion of the flue plate which such pin has displaced is thus made to possess the faculty of transmitting as much heat as is received and absorbed by nine half inches superficial."

Well; if this be not carrying absurdity to an imperial pitch, we really do not know what is. Were the evidence of the existence of the scheme less unequivocal, we should be disposed to regard the whole affair as a hoax, for we are at a loss to conceive how any man, woman, or child, could have seriously propounded such a project. But there can be no mistake in the matter. "The half-inch circular portion of the flue plate which such pin has displaced is thus made to possess the faculty of transmitting as much heat as is received and absorbed by nine half inches superficial," by which we understand, that the pin has the effect of transmitting to the water nine times as much heat as the half-inch disc it displaces. We care not, however, whether this is or is not the precise proportion of alleged beneficial effect. It is plain, that some increased evaporative efficacy is attributed to the use of the pins, otherwise they would not be used; and our reasoning, by a mere numerical adaptation, will be found equally conclusive, whether the ratio of alleged benefit be 9 to 1, or 1,000 to 999. The description of the plan given in the Mechanic's Magazine is, we have no doubt, authentic. Mr. Williams is a frequent contributor to the pages of that periodical, and the description of his plan which appears there, carries an internal evidence of having been written by himself. We have said, that the object of the spikes fixed into the iron of the flues is to increase the evaporative power of the boiler. These spikes will of course speedily attain the temperature of those particular parts of the flue where they are inserted; and our philosopher informs us, that all the surface of these iron spikes exposed to the action of the hot air proceeding from the fire is efficient heating surface. If this be true, the rate of evaporation will be about the same, whether we employ a great number of short spikes, or a small number of long spikes, provided only that the quantity of spike surface be the same in both cases; and a single spike will be as efficacious as any given number of spikes, provided it have a commensurate surface. It is manifest, too, that since a given quantity of spike surface is by hypothesis of equal, or nearly equal efficiency to the same quantity of ordinary flue surface, an excellent boiler may be constructed without any flue surface at all, the conduction of heat to the water being accomplished exclusively by the agency of spikes, or by the agency of a single spike. All that is necessary to realize this idea, is to subject sundry connected coils of rod iron to the heat of the furnace; care being taken that the one end of these connected coils is immerged in some convenient vessel of water. The faculty which these coils possess of receiving and transmitting heat in proportion to their surface, will enable them to convey the whole available heating efficacy of the furnace into the water. The heat will very obligingly run through the coils, after the same fashion that lightning runs through a metallic conductor, and an abundance of steam will be generated at the ends of the coils immerged in the water, without any boiler at all. Such is the simple development of this inimitable project. But it is plain that the profundity of our philosopher prevents him from discerning the difference between elevation of temperature and quantity of heat. We shall not insult any school boy, by reminding him, that, rapidity of conduction is *ceteris paribus* simply proportional to the difference of temperature between the hotter and the colder body: now our philosopher says, that if a red-hot bar of iron be cut into two unequal lengths, and, whilst maintained at a constant temperature, the end of each segment of the bar be applied respectively to pans containing water, the end of the larger segment will in the same time communicate more heat to the water than the end of the smaller segment. But to do this, the larger segment must be hotter than the smaller segment, while by hypothesis its temperature is the same; therefore the two bars are of equal and unequal temperatures at the same time, which is manifestly impossible. If a spike of three inches long inserted in a boiler transmit more heat to the water than a spike of one-eighth of an inch long of the same diameter and temperature, it will be necessary to diminish the temperature of the longer spike, to equalise the quantities of heat transmitted by the two. Of two spikes, then, of one-eighth of an inch in diameter, a certain increase in the length of the one is equivalent to a certain increase in temperature of the other; and it might, therefore, on our philosopher's theory, be possible to generate steam, not only without a boiler, but also without a fire. All that is necessary to attain this object is, to have plenty of long spikes; for, as increase in the length of a spike is by supposition, equivalent to a certain increase of its temperature, a dozen long spikes of a low temperature must be equivalent to a dozen short spikes of a high temperature. An indefinitely long spike, therefore, cannot but communicate heat to water, whatever be its temperature, provided it be not at the point of absolute zero. According to the same doctrine, a pint of boiling water is only half as hot as a quart of boiling water; and as to a spoonful—why a spoonful of boiling water can only exist in the shape of ice. We should be sorry to deprive Mr. Charles Wye Williams of the credit of a project which involves such important and reasonable deductions.

We can foresee, that to all we have said it will be very triumphantly objected by our philosopher and his satellites, "The accuracy of the doctrines you impugn has been demonstrated by experiment." We cry your mercy, gentlemen; that is certainly a poser: yet, though we cannot fail to be convinced by such an argument, we unhappily are not converted. We retain certain qualms and conscientious scruples, which disenable us to embrace the creed of our philosopher; yet we cannot be insensible to his extraordinary merits as an experimentalist, whereby he has obtained results such as no one else is able even to verify. Upon this part of the subject we refrain from enlarging, seeing that *we* do not possess the power of manufacturing facts *ad libitum*.

Some of this gentleman's partisans, who happen to possess sense enough to see the absurdity of his spike-boiler theory, have offered another explanation. The hot air, in its passage through the flues, say they, quickly gives out the heat originally resident in its upper stratum. The upper stratum of air is therefore comparatively cool, whilst the air in the central part of the flue is exceedingly hot. The spikes, they contend, by virtue of the impediment they offer to the passage of the hot air, create eddies within the flue, which mingle the two strata, and facilitate the absorption of the heat. But it is a fallacy to suppose that two strata of air, of great difference in temperature, can continue in juxtaposition, with the heavier stratum uppermost. And even were the case otherwise, the employment of spikes rivetted into the boiler is not essential, to produce the desired effect. Any other equally impeding substances would be equally beneficial; and fire brick would answer just as well as iron or copper. The explanation fails; yet it has the merit—a negative one certainly—of being unattended with glaring inconsistency; and it manifests the extremely reputable desire on the part of this gentleman's attendants to moderate the wildness of his speculations, and to insanify him with a few grains of common sense. But it all will not do; madmen will sometimes elude or overpower their keepers, and perform their antics before every passer-by: and this gentleman will write and will print, whatever may betide. It would be hopeless to attempt the extinction of the *cacoëthes* of a being that will rather stand in the pillory than remain unnoticed.

Let us proceed to consider the smoke-preventive plan. From what we gather from this gentleman's book, and from circulars and advertisements, we conclude that his invention for the extinction of smoke is founded upon a principle differing entirely from that of all pre-existing plans: that instead of endeavouring to *burn* smoke, as others have vainly attempted to do, he aims at *preventing the formation* of smoke, and that hence arises the unprecedented efficacy of his plan. The distinction is certainly an important one: and the chemical views which indicate the superiority of the smoke-preventive principle are indisputably correct, as will be apparent from the following remarks:—

"The combustion of smoke, as an obvious means of economizing fuel, has been frequently tried, and the attempt as frequently relinquished. The great waste resulting from smoke, the product of imperfect combustion, which must be estimated not merely in the proportion of its unconsumed carbon, but also in regard to the heat which becomes latent in its formation, and is dissipated with it in the atmosphere; and the many inconveniences which are consequent on its production, are such as to render it expedient that all schemes professing considerable economy in fuel should make the removal of these defects their starting point. Many plans have therefore been devised, and some of them of considerable ingenuity, for burning that smoke which in ordinary furnaces coal must of necessity produce, and some of these perhaps would have been completely successful, except for the radical defect they had all to contend against, originating in the chemical composition of smoke, which, once formed, can never be completely consumed without the admission of so much air as will by its cooling agency more than compensate for whatever heat the combustion of the smoke occasions. Smoke may therefore be regarded as a mixture of combustible and incombustible gases, in such proportions as to prevent the combustion of the mixture with practical economy; the incombustible portion being chiefly composed of nitrogen and carbonic acid, which prevent the combustion of smoke, on the same principle that water shaken up with it prevents the inflammation of oil. Hence the attempt should be, not to burn that which is in its nature incombustible, but to ignite the gases extricated from the coal immediately on their evolution, and without affording them the opportunity of becoming commingled with the uninflammable products of combustion."* In other words, it is gas, not smoke, that should be attempted to be burned; and this it is that this gentleman professes to do. The distinct enunciation of the smoke-preventive principle, as being susceptible of practical application, and as pregnant with the most important effects, is one thing; the contrivance of the means proper for the successful application of this principle, is another thing: and we are quite willing to render to this gentleman whatever honour appears to be due to him, for a priority in either of these achievements.

All smoke-burning projects operate upon the principle of admitting an excess of air into the furnace or flue, and this principle is attended with two insuperable and fatal objections. First, the refrigerating effect of the great excess of air it is necessary to admit to a mixture of combustible and incombustible gases, to accomplish the indispensable condition of combustion—proximity of the atoms to be combined; and second, the impracticability of apportioning the admission of air to the ever-changing quantity of smoke evolved from an ordinary furnace. Smoke-burning furnaces, therefore, although they have in some well-authenticated instances succeeded in accomplishing a saving of from 12 to 14 per cent., with the attention accorded to novel and experimental projects, have in the aggregate of ordinary working invariably been productive of a diminished efficiency, or an increased consumption. Though again and again revived, the project of smoke-burning has as often expired of perfect inanition. Yet each successive projector has had some modification to propose, which it was alleged would render success inevitable. Thus, one having admitted the air through a round or square hole, and having failed in realizing a satisfactory result, another has attributed the failure to the indiscretion of not having admitted the air through a slit, and has based his proceedings upon that discovery. One has worked with the assistance of an air valve, and another without that assistance. One has transmitted the air to the smoke through orifices in the sides of the furnace immediately above the bars of the grate; another through a hollow bridge, and a third through pipes which carry the air into the flues; the efflux of the air being in some cases through one hole, in other cases through many holes. But it is plain, that all such modifications as these leave the real difficulties of the case untouched; inasmuch as there remains the same necessity to admit a great excess of air, to accomplish anything like complete combustion, and the same impracticability of adjusting the quantity of influent air to the variable conditions of the fire. These difficulties are not inseparable from the smoke-preventive system; and we were therefore warranted in expecting from Mr. Williams some contrivance from which they would be altogether excluded, and which might be regarded as an incarnation (so to speak) of the principles of smoke-prevention. But the parturient mountain has again brought forth a mouse. This learned philosopher, after vapouring about atoms, gases, and prevention, throughout the length and breadth of an octavo volume, presents us with—what? a veritable antique smoke-burning furnace. A smoke BURNING furnace? Yes, readers, 'tis even so. You may well be petrified at this most lame and impotent conclusion. Yet so it is. Our philosopher, after raising us to the tip-toe of expectation, by promising to shew us, NOT how *smoke may be burned*, but how *coals may be burned without smoke*, ruthlessly demolishes the fairy fabric our fancy had created, and congeals us into stone, by holding up a Medusa's head, in the form of a smoke-burning furnace, of which the sole peculiarity is, that the air enters by a greater number of holes than usual. Whether of two smoke-burning projects the least exceptionable is that which admits the air at one hole, or that which admits the air at many holes, it would be irrelevant at present to inquire. Our own predilections are in favour of the latter method; though we are by no means prepared to maintain, that the admission of the air through a few judiciously disposed long and very narrow slits might not be greatly preferable to both. At present, it is sufficient for us to show that this gentleman's furnace operates not upon the smoke-preventive, but upon the smoke-consumptive principle; that it is a mere smoke-burning furnace, attended with the objections we have already mentioned as fatal to smoke-burning plans.

To the proof then. At the back of the fire bridge of this gentleman's furnace the air is admitted through a number of minute orifices, and mingles with the æriform matter proceeding from the coal upon the bars of the grate. There are no means provided of regulating the quantity of air admitted through these minute orifices, other than pre-existing smoke furnaces possessed. The only question therefore to be decided is, whether the æriform matter proceeding from the coals on the bars of the grate is gas, or smoke. To determine this it is necessary first to ascertain whether combustion does, or does not take place, in the furnace during the evolution or production of the said æriform matter. Our philosopher says that combustion does not take place, inasmuch as he has doors to his ash-pit which he shuts immediately that the furnace has received a charge of fresh coals, and which he keeps shut until the gas is all expelled. If this be done any æriform matter presented for combustion at the anterior air orifices, will certainly be *not smoke but gas*. If on the other hand combustion take place within the furnace during the carbonization of the coal, the æriform matter presented for combustion at the air orifices, will be *not gas but smoke*. The question therefore resolves itself into this Does or does not combustion take place in the furnace during the carbonization of the coal? Now if combustion do not take place in the furnace during the carbonization of the coal, and as the volitilization of the unfixed parts of the coal requires a large amount of heat for its accomplishment, there must be some available source of heat other than combustion from which the requisite quantity is supplied, our philosopher says that the red hot embers of the fire are this source of heat. But it is manifestly impossible for any body to give out half its heat to another body and remain as hot or nearly as hot itself. Besides the great quantity of heat which becomes latent when solids or liquids are transformed into gases, is left without any provision. A very simple computation would show—the weight, temperature and specific heat of the incandescent embers, and the weight, temperature and latent heat of the gases, (or what is equivalent—their weight, temperature, volume and specific heat) being given—that no practicable method of working this gentleman's furnace, would render the embers on the grate an adequate distributor of the heat requisite to expel the gases resident in the coals which constitute a charge of the furnace. But it would be preposterous to resort to Algebra to establish a self-evident proposition. Every one knows that if green coals be thrown upon a fire, and at the same time air be excluded, the coal will not be carbonized, but the fire will go out: and even in a coke oven carbonization will remain unaccomplished, unless air is admitted. If this effect be consequent upon the exclusion of air even where the process of carbonization is *aided* by the heat of a mass of incandescent brick work, how preposterous would it be to conclude that carbonization can take place in a hermetically sealed boiler furnace, where the process is *impeded* by the refrigeration of the water of the boiler! If then there is no combustion in this gentleman's furnace, and if at the same time gas is evolved, there remains no conceivable source of the heat absorbed during volatilization, except the act of volatilization itself; and to say that this is the source of the heat, is tantamount to saying that cold water is not merely able to raise itself into steam, but to leave a considerable surplus of heat after having done so. We have no alternative then but to conclude that combustion does go on in this gentleman's furnace, if it be in action at all. If there is combustion, that combustion is either perfect, or imperfect: if perfect, there is no necessity for any appliance, either smoke consumptive or smoke preventive: if imperfect, it is not gas but smoke that is evolved, for the very definition of smoke is the product of imperfect combustion. This furnace is therefore a smoke generating, and consequently a smoke burning furnace. He may *say* otherwise. He may call it a patent Argand, or patent any-other-and, but a smoke burning furnace *it is*, and we defy him and his legion of chemical professors to prove the contrary.

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* Thoughts on Steam Locomotion. London: Weale, 1840.

Upon what ground then can we be called upon to believe that this smoke burning project will be one whit more beneficial than other smoke burning projects, in all essential points identical with it? And what shall we say of those who have lent themselves to the reputable endeavour of puffing off the paltry nostrum? Of such men as Mr. Brande and Dr. Ure, it is painful to be obliged to speak in any other terms than those of commendation and respect. Their names are household words: and we are distressed at anticipating the possibility of such names becoming epithets of contempt, instead of continuing to be expressions of reverence and admiration. We trust therefore that the attempt to elevate this ponderous gentleman, will be relinquished. The attempt exhibits much good nature, but very little good sense—and it *must* be unsuccessful. A tortoise can never be taught to fly by being hoisted into the air—and though a dunghill cock may by dint of extraordinary exertions wing a flight of 20 yards at the height of three feet above the surface of our planet, yet the achievement only serves to show that he is any thing but an eagle, and that his native mire is his most appropriate element. There is no real kindness in trying to raise this gentleman out of his appropriate and very humble sphere; and is Mr. Brande so confident of the imperishable virtue of his laurels as to suppose that they have nothing to suffer from so ill judged an attempt? Is Mr. Brande likely to enhance his own reputation, or the value of his art, in the estimation of practical men by telling them that the product of the destructive distillation of coal is rendered uninflammable by mixing with the cold air in the chimney, and at the same time praising a project possessing to correct the evil by introducing a still larger quantity of cold air into the flues than is usual? Of Dr. Ure's attainments in every department of the philosophy of the arts there can be but one opinion; and we should perhaps attach a value to his praise commensurate with our sense of his ability, had we the assurance that he was a landed proprietor of ten thousand a year, which we regret to find is not the case. It is really a reproach to this country that abilities like Dr. Ure's should be wasted in the ignoble occupation of compiling or revising specifications of patents, and furnishing encomiums to patentees; and we do trust that the award of some adequate place or pension to this distinguished philosopher, will speedily remove such a stigma from our land. As to Doctor Kane of the Apothecaries Hall, Doctor Brett and Mr. Something a chemist of Leeds, we need only say that we shall not condescend to notice such celebrated gentlemen, further than to assure them that they would find much more reputable occupation behind their counters dispensing mercurial pills and doses of Glauber, than in soliloquising about things of which they know nothing. They may save themselves the trouble of casting *their* perfume upon the violet. Engineers and boiler makers know their business much too well to lack instruction from a pack of effervescent chemists and druggists.

Having shown that this gentleman has failed in producing any contrivance capable of giving practical efficacy to the smoke preventive principle, it only remains that we should ascertain whether he is entitled to the merit (if it be any), of having been the first to suggest that principle—the first to distinctly enunciate the doctrine that the smoke preventive principle is practically applicable and peculiarly beneficial. The circumstance of having himself failed of making any practical application of this principle, does not deprive him of whatever honour may be attached to the distinction of having been the first to suggest it for practical application in the furnaces of steam boilers. This point must be decided chiefly upon the evidence of dates, and as the inquiry is only of collateral interest, we must hurry over it as quickly as we can.

The first edition of Mr. Williams's book on combustion was published in 1840, but *posterior* to the essay entitled "Thoughts on Steam Locomotion," published the same year, from which we have already given a quotation. This essay is anonymous, but is, we understand, ascribed to Mr. Bourne, and it contains a clear though a concise exposition of the principles and advantages of smoke-prevention. This gentleman's patent was, it is true, taken out in 1839; but Mr. Bourne, we are informed, has a patent for the same thing, of the date 1838, and a paper descriptive of this patent, written in 1838, and now before us, describes the patent to be for the "prevention of smoke, and economization of fuel." We have also before us a copy of a letter written by Mr. Bourne in 1837, of the date September, which develops in the first place, the hopelessness of the endeavour to *burn* smoke; and in the second, the benefit derivable from the smoke-*preventive* principle, which is shewn to be practically available. "Smoke," says this letter, "*cannot* be effectually burned; the object should therefore be to prevent its formation." We have also before us reports by Dr. Lardner and Mr. Farey, of the date of January, 1838, relative to Mr. Bourne's invention, and other papers and documents, which it is unnecessary to mention. Now, up to the end of 1837, Mr. Charles Wye Williams had done nothing whatever in smoke-prevention. In 1838, even, he was occupied, not with schemes for the prevention of smoke, but with projects for making resin and other artificial fuel—projects, of which the smoke-preventive project was the immediate successor, —whilst we have evidence which shows that Mr. Bourne's experiments tentative and illustrative of the advantages of smoke-prevention, extend as far back as 1834, years before this gentleman had turned his attention to the subject.

So far we have only shown that Mr. Williams has no pretensions to that priority in the development of the superiority of the principle of smoke prevention claimed for him by some of his certificate-mongering encomiasts. Let us go a step further and inquire whether he is entitled to the merit of independent development or invention. He *may*, at the time he commenced his operations, have been in perfect ignorance of all Mr. Bourne had previously said or done. Our readers will find little difficulty in concluding whether or not he *was* in ignorance, when we inform them that the letter which we have already mentioned as containing a complete development of the principles and advantages of smoke-prevention, written in September, 1837, was addressed to Mr. Williams himself, confidentially, at his invitation; and that it was shortly after the reception of this letter that Mr. Williams threw aside resin fuel, compressed peat, and a host of kindred projects, and commenced might and main upon his own account, on the smoke-preventive plan.

ON EXPLOSIONS OF STEAM BOILERS.

In another part of the *Journal* we have given the evidence taken before the coroner at an inquest held in consequence of the death of several individuals, occasioned by the bursting of a boiler at Messrs. Elce & Cottam's manufactory at Manchester. We now have an opportunity of giving the translation of a letter from Mr. Jobard, of Brussels, to the Baron Seguier, on the principal cause of the explosion of steam boilers, which may throw some new light on the cause of the accident.

"When the water in a boiler becomes so low as to leave some part of the sides exposed to the direct action of the fire, those parts are raised to a red heat; the received opinion is, that the steam, coming in contact with the heated iron, is decomposed, and forms hydrogen gas, but not to such a degree as to become explosive, because a considerable quantity of oxygen, or atmospheric air, which does not already exist in the boiler, is required to render it so. It is, however, this very air, which, I consider, does really enter the boiler in considerable quantity, and is evidently supplied by the feed-pump itself, which, from some cause or other, although it continues at work, thus permits the water to lower in the boiler. In such case every stroke of the pump injects a certain portion of air into the boiler. There might also exist a slight crack, or a defect in the working barrel, or in the packing of the stuffing-box. These defects would cause the feed-pump to become a real air-pump, if any accident happened to the valves of the induction pipe, or if the water in the reservoir got below its proper level. There can be no doubt that these accidents do occur.

"Let us now examine what takes place when atmospheric air is thus forced into the boiler. This air passes through the remainder of the water in the boiler, and occupies the space above the injection pipe, without being immediately mixed with the gas, which continues to be produced from the heated sides of the boiler, but so soon as the engine is set to work, a considerable ebullition is produced in the water, and a detonating mixture of air and gas is formed. So soon, therefore, as this explosive mixture comes in contact with the heated surface of the boiler, it inflames in the same manner as carburetted hydrogen gas does against the wire of a Davy's lamp when heated to a cherry red.

"There is also another means of accounting for the firing of the explosive mixture, namely, by the electric spark which is formed every time that the steam is struck or forcibly pressed by the edges of the valve, as was shown in the experiments made by the Commission at the Museum, and as you yourself witnessed in those with the engineer Tassin. The experiments of Lavoisier show that if a valve be opened at the moment the explosive mixture is in contact with it, the slightest electric spark is sufficient to cause an explosion. It might also happen that the disc of the valve produced the effect of the plate of the electrical apparatus, and caused the spark on being lifted from its seat.

"This will account for the greater part of the explosions happening at the moment the engine is set to work, or the valve opened, as occurred on the 13th of November, 1841, at the manufactory of Messrs. John Elce and Cottam, at Manchester.

"There can be no longer any doubt as to the production of hydrogen gas in boilers where the water is deficient, since the dangerous experiment made by Mr. Goldsworthy Gurney, when he proved that the steam emitted from a boiler heated red hot (the feed pumps being stopped and the water suffered to get low), burnt like hydrogen gas: the only reason that this boiler did not explode must have been, that in this particular instance there was no atmospheric air mingled with the gas.

"In support of this theory, several cases of explosion have come to my knowledge, among others, one that took place at Ghent in the year 1826, which puzzled all the believers in the efficacy of safety valves, as the man-hole was open, and there was no water in the boiler, or fire under it; yet it exploded, and caused great damage. This accident may be thus explained:—

"The boiler had been emptied on the Saturday, in order to clean it on Sunday, leaving only a little water in it to wash it out. This boiler having been emptied before the fire was completely extinguished, must have been heated in parts to a red heat, and thus the steam decomposed. The next morning, the workman, having taken off the man-hole lid, held his lamp, according to custom, within the boiler. The hydrogen gas, rendered explosive by the admission of atmospheric air, immediately exploded, and destroyed the boiler and workshop, and killed the man.

"As the water cannot be thus decomposed in *copper* boilers, they are consequently not liable to explosion from the cause thus shown.

"In discovering this cause of accident, its remedy is evident; if the reservoir for the feed is placed above the pump, as is invariably done in Prussia, the introduction of air into the boiler becoming impossible. This arrangement, enforced by law in Prussia, has caused explosions to be of rare occurrence.

"If my opinion on the cause of explosions be correct, and which it is desirable should be verified by official experiment, the regulations at present in use are worse than useless, safety valves become dangerous, and the fusible plates are of no avail. The chief attention ought to be bestowed on the supply of water in the boilers, and then the explosion of boilers rivetted by machinery need not be feared, because the rivet holes become oval before giving way, and permit the steam and water to escape by the seams of the boiler. It is hoped this succinct explanation will enable the proprietors of steam engines to take the necessary measures to avoid explosions.

JOBARD."

ENGINES OF H. M. STEAM SHIP "VIRAGO," OF THREE HUNDRED HORSE POWER.

BY BOULTON, WATT, AND CO. DESIGNED JUNE 1841.

(With an Engraving, Plate II.)

THESE engines are of the kind termed "direct," and were designed to meet the views of the late Board of Admiralty, with reference to the saving of weight, space, and placing all the moving parts below the line of flotation, out of the reach of shot.

They are of the collective power of 300 horses, cylinders 64¾ diameter and 5 feet stroke, the velocity of piston being fixed at 215 feet per minute, agreeably to the general rules of the late Mr. Watt.

The Boilers are made to the *full power* of the engines, as it regards evaporating surface, and occupy 19ft. × 20ft. superficial, and in height they are 12 feet.

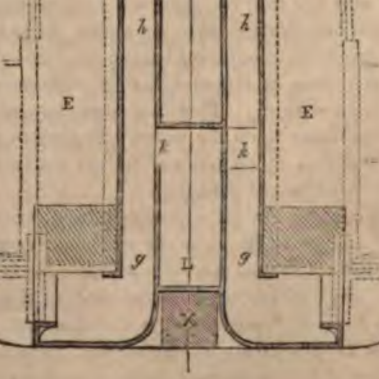
The length of the engine room is 53ft. 6in., and the coal boxes are constructed so as to entirely protect the boiler and engines, and contain from 350 to 360 tons of coals, (at 48 cubic feet per ton). The space required by the engines is 18ft. 6in. athwart, and 11 feet fore and aft, that is, over the air pumps, which being placed in the centre of the vessel, occupy comparatively useless space,—for so large a power as 300 horses we believe this to be unprecedented. It will be observed that there are two condensers, air pumps, &c., so that either engine can be worked separately; in consequence of the compactness of the engines, the weight must be very much reduced in comparison with the beam engine.

REFERENCE TO THE ENGRAVINGS.

Similar letters refer to similar parts in each figure.

Fig. 1 is a Front View of the Engines. Fig. 2, Plan. Fig. 3, Side View. Fig. 4, Horizontal Section of Air Pumps and Condensers.

Fig. 5.—Transverse Section through Condensers, Hot Water Cisterns, and Eduction Pipes.



A, cylinder; B. piston rod; C. connecting rod; D. guides for piston rod cross head; E, brass sliding valves; *f*, induction steam pipe; *g*, eduction pipe from lower thoroughfare; *h*, ditto from upper thoroughfare; *k*, openings into condensers from eduction pipes *g* and *h*; L, condensers divided in the centre; M, hot water cistern; N, air pumps; *o*, foot valves two to each air-pump; P, beam to work air pumps, feed and bilge pumps; R, feed pumps; S, bilge pumps; T, waste pipes; U, bilge water pipes; *v*, holding down bolts; *w*, doors to condensers; X, keelson running through condensers; *y*, engine sleepers.

ENGINES OF H. M. S^T. V. VIRAGO. 300 H.P. BY BOULTON, WATT & C^O.

Designed, June 1841.

FIG. 1.

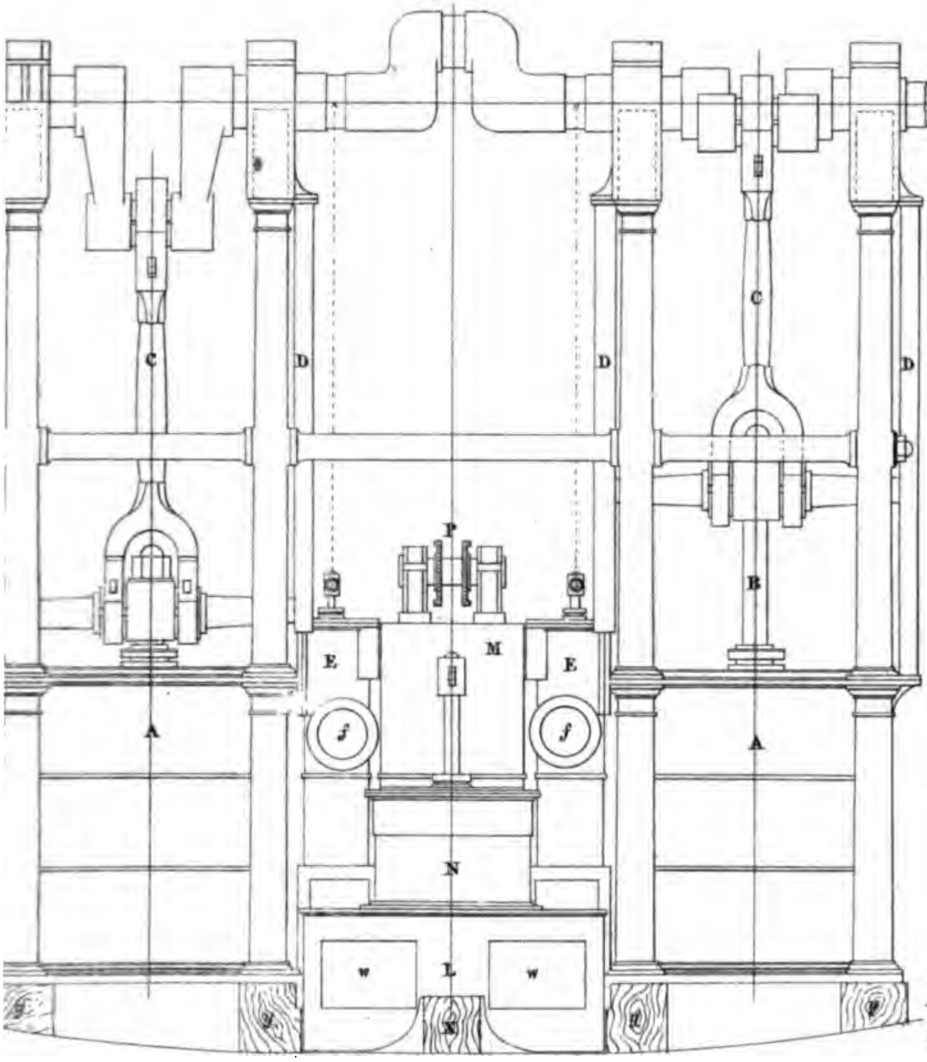


FIG. 3.

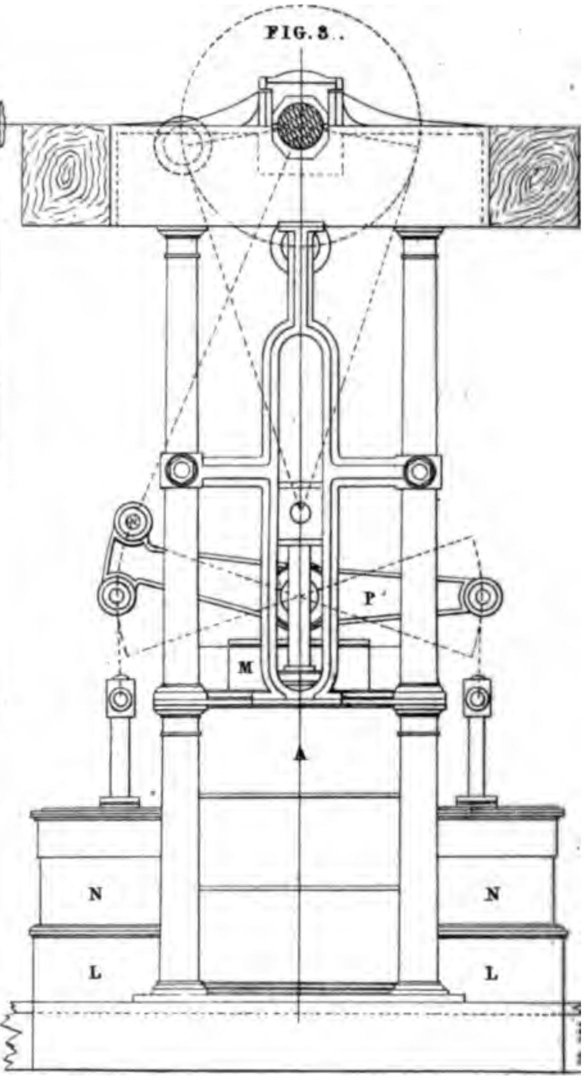


FIG. 2

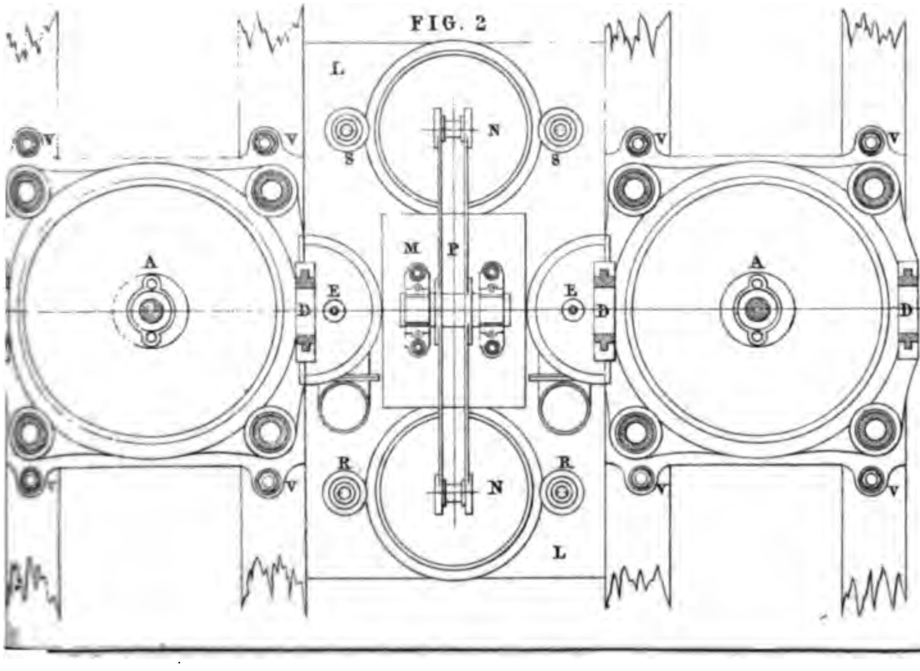
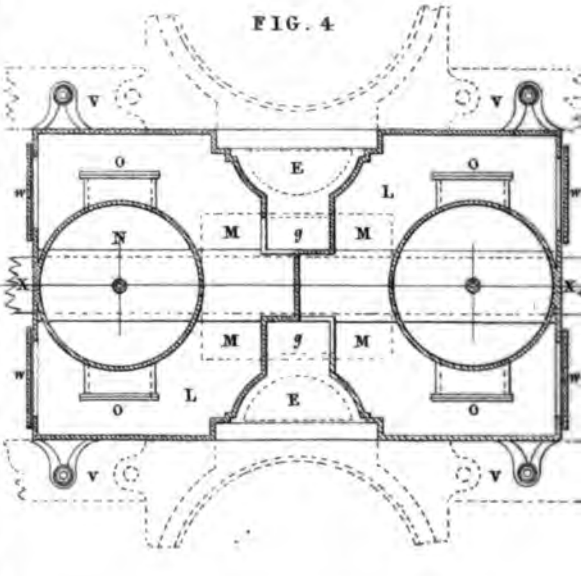


FIG. 4



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TILDEN FOUNDATIONS

ON EGYPTIAN ARCHITECTURE.

In commencing this subject it is requisite to premise, that we intend to limit the inquiry—except as far as collateral illustration may be requisite to throw a light on the subject—to the temples and palaces of Egypt. A glance at its domestic architecture, as far as our imperfect knowledge in that particular extends, may be permitted. But the sacred cave and the pyramid belong to an anterior period of civilization; that which immediately followed its first stage—the period of cairns and of rough stones, set up for memorials of events. The first cannot be comprised in the term architecture, the latter can. But dissertation on the pyramids and on the pyramidography of Egypt, would burden or complicate the subject, or cause it to deviate from the right track to its appropriate point of view. It would, it is true, furnish materials for a long and elaborate essay. Such an essay might not be uninteresting to the readers of the "Civil Engineer," nor out of place in its pages; especially after the curious and romantic discoveries of Caviglia, the ardent inquiries conducted on the spot by Colonel Howard Vise, and the recent and elaborate publication of Mr. Perrin, the civil engineer, giving such minute details of the great pyramid's structure, both exterior and interior, that the most untravelled reader, in his arm-chair, may form as correct an idea of the whole astounding fabric, as the most adventurous traveller who has dived, by the aid of a frail cord, amidst Arab ejaculations, to the bottom of the well, or disturbed the long repose of the bats in the mirky and squalid recesses of the closet over the central room. But for the reason we have assigned, and with a view equally to commodious brevity and lucid order, we shall, as we premised, confine ourselves to the palacial and ecclesiastical architecture of Egypt.

The character of the Grecian temple was grave and dignified beauty, while that of the Ionian was voluptuous elegance. The Roman expressed the ambitious magnificence of the founders. The essential type of the Egyptian temple was sublimity. The sacred edifices of ancient Egypt were impressed with the sublime characteristics of the universal deity to whom they were devoted. Greatness of dimension was so contrived as to imitate infinity by uniformity of succession. On the same principles of succession and uniformity, the grand appearance of all the ancient Doric temples of Greece and Magna Græcia, which may be generally designated as oblong forms with a range of uniform pillars on every side, will be easily accounted for. From the same cause, also, may be derived the grand effect of the aisles in many of our old cathedrals. The long avenues of sphynxes which preceded the approach to the Egyptian temples were constructed on the same theory; long ranges of unhewn stones occupy the same position in forming the approach to the circular temples of the Druids. Denon, Belzoni, and Champollion describe, in vivid and forcible language, the effect produced upon them by the sublime character of the Egyptian temples. Denon says that when the French army came in front of the temple of Tentyra, they were seized with a simultaneous feeling of admiration, and halting on the plain in front of the portico, demonstrated their wonder and delight by a general acclamation and clapping of the hands. Whence did this consummate perfection arise? The architect, in the social scale, was ranked next to the Prince. The art and the artist were studied and valued as they ought to be, in Egypt. An architect was, according to the true definition of the term, superintendent of the works and workmen. He was the creative mind (*nous*) presiding over the mechanical producers of the greatest labours that human ingenuity and labour are capable of creating on the earth.

Certainly the old architects connected all the deepest mysteries and profoundest secrets of theology and science with the forms of architecture, and with the lines, angles, and curves of masonry. Hence arose freemasonry. The Dyonysiacs who were privileged to build the sacred edifices of Asia Minor, and the theatres of initiation which were attached to the most celebrated, as they were at Memphis and Eleusis, were freemasons. Their first great lodge was possibly the great pyramid; their dramatic mysteries, the origin of the modern drama, were founded on the judgment of the dead; their secret signs were confessedly derived from the geometrical theology and philosophy of the Egyptian masons, and were handed down to the professors and masters of the monastic architecture of the middle ages, An architect of this class was of necessity imbued with all the theological and scientific knowledge of the sacred colleges. His works may be said to represent the various eras of civilization, and the successive steps of man's social and scientific progress.

The eye of disciplined taste can readily discern what the common observer cannot—four distinct periods in Egyptian architecture: first, the period of pyramids, cairns, rock-built forts, granaries, treasuries, and sculptured tablets or steles; second, the period of sculptured temples, which succeeded the former, whether troglodyte—*i. e.* sculptured from the face of the rock—or detached and isolated; third, the period of the rise, progress, and maturity of architectural forms, which may be traced from Osirtesen to Sesostris; fourth, their decline and fall, which may be traced to that period till their total corruption under the Greeks and the Romans. With respect to the first period, as connected with Egyptian architecture, very little can be said. It is to the temples and palaces exhibiting architectural design that we shall confine ourselves. The period, however, exhibits a remarkable analogy, and seems to indicate a particular fact in the history of the first colonization of nations. The architectural and sculptured forms of the first period resemble the sculptured forms preserved on the old temples and palaces of New Spain, ascribed by writers to the Tultecans, who preceded the Mexicans 600 years, or by the native Indians to the Giants, or wandering Masons, a well known designation of the expelled Cyclopean or Shepherd family. It is still more singular, that the monuments on which these sculptures appear, or connected with them, resemble the unvarying characteristics of those which are called Cyclopean, and many may doubtless be ascribed to them without exaggeration. Some of the pyramids erected by them are larger in base than those of Egypt, and composed of equally permanent materials; their rock-hewn Treasuries resemble in every respect the Cyclopean fabric called the tomb of Atreus. Their fortifications resemble similar Cyclopean structures at Tyrins, and elsewhere; and their subterranean sepulchres are approached by similar descending galleries, and distributed into similar sepulchral rooms. Their palaces are characterised by galleries constructed with the well known Cyclopean arch, consisting of receding courses of stone in a triangular form; in one of these monuments, viz, the flower temple of Oaxata, appear individuals precisely like those called the Pomasata, conquered by Sesostris, both in physiognomy, head-dress, and costume. Now were these the same people? were the Pomasata a branch of the Shepherd race? was there any affinity between them and the aboriginal American Indians? We do not affirm it, because the mode of reaching America, either aboriginally or cotemporaneously with Sesostris, would still be unaccounted for. But another remarkable fact should be added, which gives additional reasons for the inference, though it does not prove it. These men are red and beardless, ever the well-known characteristics of the American Indians. Were they then East Indians, as Champollion supposes, and was America originally peopled, as many learned men have argued, from the East Indies, and from the adjacent Indian isles? If, then, the Tultecans, or whatever nation built the monuments ascribed to them, came from the south of Asia, it is quite certain that the Asteks, or Mexicans, came from the north of Asia, and, conquering them, occupied their place; the passage across Behring's Straits is no great geographical difficulty. With regard to the period, extending from Osirtesen to Sesostris, it is indicated by a gradual rise from primitive simplicity to magnificent and gigantic form; but there is scarcely any difference in the archetypal model of their temples and palaces, or in their sculptured ornaments, except that the first were more primitive, more limited and simple, while the last became successively ostentatious, complicated and magnificent. The second period was equally characterised by troglodyte, as detached temples and palaces. The last period, in which the architecture of Egypt was corrupted by Roman and Greek innovation, requires less comment, as it must be obvious to the casual observer. The first period is at once distinct and remarkable. The republican forms of government of the great pastoral community, as Aristotle proves in his history of all the first republics, clearly assignable to this extraordinary race, and generally embracing a community of goods, were disseminated throughout the world wherever their wanderings led. These people carried with them in their wanderings all the favourite forms of the pastoral or Cyclopean architecture—pyramids, gateways, triangular or graduated arches without the key-stone, cellular cairns, unsculptured initiatory caverns, irregular courses of colossal masonry, cylindric columns, and rock-built fortresses, which, wherever they are found, attest their presence. These were superseded in Egypt by the more magnificent forms, costly embellishments, and tasteful refinements of the inscribed temples and palaces of the eighteenth dynasty of monarchs who expelled them. The sublime and magnificent monuments erected by this ancient race of monarchs on the plain embraced by "Hundred-gated Thebes," attest to this day their taste, their ambition, their wealth, and their power. They suggest ideas of the works of fabled enchanters rather than of ordinary human beings. Of that Thebes Homer wrote twenty-five centuries ago—

* * 'ουδ' οσα Θηβας
Αιγυπτιας ουθι πλειστα δομοις εν κτηματα κειται,
Αι θ' εκατομπυλοι εισι, διηκοσιοι δ' αν' εκαστων
Ανερες εξοιχνευσι συν ιπποισιν και οχεσφιν'.

It was on that myriad-columned plain, beneath its gorgeous archways and gigantic colonnades, that Champollion, in the excited language of astonishment, exclaimed, "These porticos must be the work of men 100 feet in height! Imagination sinks abashed at the foot of the 140 columns of the hypostyle hall of Karnac." It was there that Belzoni, filled with the fervour of dreamy enthusiasm, which, as he says, raised him above the petty cares of mortality, pronounced his joyful *Eureka*, and exclaimed, "I have at least lived one day."

"It appeared to me," he added, "like entering a city of giants, who, after a long conflict, were all destroyed, leaving the ruins of their various temples as the only proofs of their former existence." One brief passage will depict the architectural ambition of these great monarchs. Our well-known column called "the Monument" has been deemed a wonder. The great hall of Karnac was supported by 140 columns, most of the same diameter, and some of two-thirds the height of that "Monument." The illustrations of Rossellini and Champollion prove that imagination itself has scarcely invested this line of potentates with attributes of too surprising a character.

A few preliminary words on the domestic architecture of Egypt, may be expedient for the purpose of clearing the ground. One step led from the sacred cave *(heron antrou)* to the tomb, and one step from the tomb to the palace. The house of the dead was, probably, in all instances, as well as those of royal and illustrious personages, meant to be a shadow of the living. The tomb of Psammis, opened by Belzoni, or rather of Petamon, as we read the Phonetic characters of the royal inmate's name, supplies no doubt a good image of the interior chambers, staircases, communications and accommodations of a royal palace, or of the hotel of a Theban Magnate. Of the house of the merchant and tradesman we have an extant model. Among the most curious of the memorials of the new Egyptian Room, British Museum, is the model of an Egyptian dwelling in "hundred-gated Thebes," which was, as Homer calls her, the "proud mistress" of the world. It is on the left hand side in case K 2. It had probably been a child's doll house, but the representation is not the less accurate and curious on that account. It appears to be the dwelling of a corn-factor. The model is an oblong of 2 feet in length by 18 inches in width; the walls are 5 inches in height, and the door, which is near the angle of the side, is 4 inches in height by 2 in width. We see, in its simple construction, the model of all the private houses in the East up to the present time. It is the model, on a smaller scale, of Homer's palace of Ulysses, in Ithaca. It is the model of the old-fashioned inns in this country, which were originally constructed like the caravanserais of the East. A high wall, without windows, conceals the mansion from the street. It is entered by a portal, which appears almost similar to the doorways let into similar dead walls in Cairo at the present day (as described by Captain Lane). The rude wooden bolt by which it is fastened, passing, when shut, nearly across the entire door, appears to be an improvement on that of Ulysses, who merely used a cord and a knot to fasten the royal bedchamber door. The door opens into an interior court, at the end of which are warehouses of corn, the windows of which are closed by similar wooden bolts. A staircase ascends from the court to a gallery, which had two chambers above, one without, and the other with, a roof; the first probably being the sleeping, the latter the dwelling apartment of the mansion. It is probable that the defensive arms and valuables of the family were kept here, as they were in an analogous situation in the palace of Ulysses. In order to complete this sketch of the domestic architecture of Egypt, one example (the only one extant) of a royal or lordly mansion, intermediate between the merchant's dwelling and the temple palace of the pontiff kings, exists in the Banquetting Palace or Pavilion (as it is called in the French great work "*D'Egypte*") at Gournu. *It has two floors*, the upper exhibiting the only instance of windows in the Egyptian style, harmonizing with the sloping doorways. The lintels of the windows are ornamented with the zigzag mouldings, and the imposts are elegantly enriched with the globe and winged serpents. A balcony has been supported by caryatide heads of conquered people. The front elevation is handsomely crowned with a semicircularly crenated parapet. The whole, if restored, would make a striking front for a mansion or Regent-street shop. It has had two projecting wings, forming, with the *corps de logis*—(like Buckingham Palace and the Louvre)—a quadrangle which may have been completed by a palisade or propylon,—the origin of the triumphal arch. The interior decoration is light and graceful, unlike the usual severity of the Egyptian style.

The ordinary model of Egyptian temples and palaces was grandly simple, but extremely monotonous. Nothing could be more uniform. Two obelisks first, and then two seated statues, sometimes two andro-sphynxes, usually preceded a gateway, permeating two turrets constructed in the form of flat truncated pyramids. The gateway gave access into a quadrangle, the covered cloisters of which were usually supported by pilasters and caryatides. At the extremity of this quadrangle another gateway lead into a second colonnaded court; the gigantic face of the colonnade, facing the entrance, constituted the open portico of the temple. Sometimes the judgment hall, as at Luxore and Karnac, supported by larger and loftier columns than those of the portico, succeeded. Then followed the Pronaos, and six smaller chambers and Sekoi, as it might happen, all roofed and dark, sometimes supported by caryatide pillars and sometimes not, and uniformly terminating in a rectangular isolated small chamber, which was the "holy of holies," and usually contained either the monolithic cage of the sacred animal worshipped within the temple, or the sculptured and seated forms of the three-fold divinity, which presided over the sacred edifice.

This was the ordinary form of the principal temples, including the ecclesiastical palaces of the pontiff kings. In the more ancient temples generally sculptured from rocks, as well as those of districts which were more limited in expense, the gorgeous accessories to which we have referred, such as avenues of sphynxes, obelisks, statues, colonnaded courts, many pillared porticos, and judgment halls, were retrenched, and the temple assumed the more primitive character of a double columned portico, and three rock-hewn chambers, the pronaos, the naos, and the holy of holies.

We shall find, as we examine the most ancient temples of Egypt, which stud the two rocky sides of the Nile with magnificent relics, from the southern confines of Nubia to the cataracts of Philæ, that the general description we have given of the ecclesiastical monuments of Egypt, applies, with slight variations, through the whole series, to one prevailing and unvarying archetype.

Thus the ground plan of the great palace of Luxore resembles, though far short of it in colossal dimensions, the ground plan of the astonishing temple and palace of Karnac. It is clear, from history and extant relics, that the same analogy is assignable to the almost obliterated palace built by the celebrated Memnon.

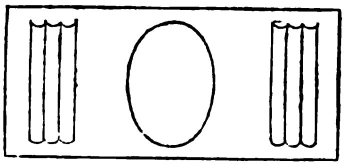
Let us glance at the most authentic accounts of the modern ruins of the Memnonium, in order to carry out our example. The two seated and broken statues, both ascribed to Memnon, but one identified with his vocal statue by the inscriptions on the leg, now the most conspicuous objects on the great plain of Thebes, preceded the gateway. They may have been preceded by an avenue of sphynxes, and succeeded by obelisks. They are at a considerable distance from the first gateway, and front the Nile, but they are in perfect line with the entire direction of the remaining ruins. "Within the first court, close to the pyramidal gateway, is a large colossal statue," says Pocock, "broken off about the middle of the trunk." The head of this statue was brought, after much labour, to England by Belzoni, and is now in the British Museum. Here it has obtained the name, though fallaciously, of the younger Memnon. "In the second court," says the same author, continuing his description, "are the remains of two colossal statues sitting, of black granite, the head of one of which is three feet five inches long." This second court of caryatide columns, a third court follows, in which are the remains of two seated colossi of black marble, one of which is also in the British Museum. A fourth court succeeded, which is not characterised by any remarkable remains. This court was probably, in its integral state, surrounded by a colonnade, as that portion of it which fronts the entrance, and which formed the portico, remains. The portico is primitively simple but sublimely impressive in its character. It consists of pillars of the oldest style of architecture, resembling those of Elephanta, in India, having large gourd-shaped capitals instead of cushions, which, in the latter case, appear compressed by the encumbent architrave. This leads into the pronaos, roofed and supported by gigantic columns, much loftier than the preceding, and having bell-shaped capitals. Another portico, with similar capitals and columns, follows, and most likely, like the preceding, formed one side of another quadrangular court, being the fifth, and at this the ruins end. It is probable that a considerable number of courts, porticos, *sekoi*, may have occupied the intervening space between this part of the ruins and the excavated tombs of the kings. Judging from the line of direction which the series of ruins take, and from the analogy of the sepulchral Palace of Osymandes, this would seem to be the case. Let us now see whether there be any probability in the supposition that Diodorus Siculus, in describing from Hecateus the sepulchral Palace of Ismendes, described in fact the Memnonium. Norden and Pocock show themselves to be decidedly against this opinion, by searching for the remains of the temple of Osymandes at Luxore, on the eastern bank of the Nile; for Diodorus Siculus gives the account from Hecateus, after describing the other sepulchres of the Theban kings, which are notoriously on the western bank, and not far from the Memnonium. It is true that they discover paintings in Luxore similar to those which Diodorus Siculus describes as being in the palace of Osymandes. But it is not probable that the pictorial narrative of such exploits should be confined to one locality. Indeed, similar representations are found at Ipsambul. The real fact is, (and considering the vicinity of the royal tombs, it goes far to establish the identity of the Memnonium with the sepulchral palace of Osymandes,) that the very pictorial sculptures referred to by the historian, are seen at this day in the Memnonium. The modern ruins, too, correspond with the description of Diodorus. First there are entrance courts, after passing the usual entrance gate between two towers (truncated pyramids). After this there was a colonnaded quadrangle, supported by "animals after the antique manner," says the historian, and as, indeed, is observable in the temples of India and Japan to this day. The roof of this quadrangle was "spangled with stars on a sky-coloured ground," as in "Belzoni's tomb," as at Dendereh, and other extant palaces and temples. Another unadorned court followed. In this were three statues, all of one stone, erected by or for "Memnon the Syenite." One of these was the largest in Egypt, and was in a sitting posture. The first exceeded seven cubits in length. The other two, which were not so large, were placed at his knees, one on the right, and the other on the left. This was the famous statue of Osymandes, on which the boastful inscription, "I am Osymandes, King of Kings," was written. This has been supposed to have been the vocal statue of Memnon, the word Ismendes meaning *to give a sound*. That this, however, is not the broken column of the plain is quite clear. It is accompanied by another, and neither are so large as the one described. There can scarcely be a doubt, however, that this is the statue described by Norden as broken in the middle, and lying in the entrance of the second court of the Memnonium. The size precisely agrees. It was 42 cubits or 63 feet high, and the foot described as 7 cubits in length lies there at this day, and was seen successively by Belzoni, Capt. Light, Leigh and other travellers. It can scarcely be doubted, therefore, that the sepulchral palace of Osymandes was the Memnonium. After this court there followed another colonnaded quadrangle, "of more note than the first." In this was pourtrayed all the King's wars against the Bactrians." Upon the first wall the King was represented storming the wall of a city surrounded by a river, and fighting in the front of the battle against his enemies, with a lion by his side, and making terrible slaughter." This battlepiece, perfectly concurring in every particular with the historian's description, has been copied by Champollion. "On the second wall the King was represented leading his captives." This was also copied by Champollion. "The captives were engraved without hands, to indicate their unmanly character." This representation is also given by Rossellini and by Champollion, the King being seated in a car, a pile of hands before him, and the captives (Bactrians, probably, by their costume, with plaited locks, beards, and striped tunics open in front) waiting the operation of the executioner. "The third wall represented the King offering sacrifices and celebrating his triumph." This historical picture, in all its elaborate details, is copied by Rosellini and Champollion. The proof, therefore, may be regarded as curiously established, that the Memnonium was the sepulchral palace of Osymandes. "On the fourth wall, says the historian, two statues were placed sitting, each 27 cubits in length." These are clearly the same as those described by Norden in the second court, that which follows the caryatide court. "Two sitting colossal statues of black granite, the head of one of them 3 feet 5 inches long.

"Near to these," says Diodorus, "three passages led out of the colonnade into a hall supported by pillars into a musical theatre. This agrees with the Covered Hall (the Hypostyle Hall at Karnac is built in the same manner) supported by columns which still remain, and which was faced on both sides by a colonnaded court, the pillars of which are lower, and of different capitals from those which support the hall. This appears to have been the judgment hall or court of the 40 nomarchs or judges, where they held their sessions, and where the thirty days general assemblies of the people were also in all probability convened. Norden, speaking of its decorations, says, that "they surpass in strength and beauty every thing he had seen in al fresco or mosaic work;" and that "the gold, ultramarine, and other colours employed had preserved their lustre unimpaired."

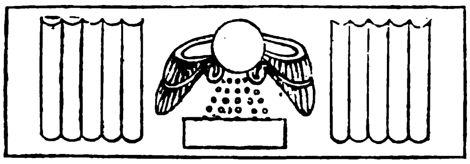
The chief variety in the forms of the columns has been described. Were the five orders known to the Egyptian architects? The negative must be admitted. The Doric alone can be claimed by the Egyptian architects, as borrowed by their Greek colonists and pupils. Rosellini settles this point by exhibiting the Doric column and entablature in the portico of the tomb (containing the tableau of Joseph and his brethren) at Beni Hassan. However, the elements of the capitals of the four remaining orders may be detected among the colonnades and porticos of the Egyptian temples. The germ of the Ionian volute and capital (both derived from a female face and its ornaments) may be seen at Dendireh and Philæ.

It has been remarked that the pillars of the Hypostyle Hall at Karnac are Saxon in their waved ornament, bell-shaped capital, and sturdy cylindric shaft. Many of the capitals employed by the monastic architects (see the multiform capitals in the "Temple Church," by Robert Billings) are strikingly like the exuberant variety of graceful forms, derived from trees, flowers, tendrils, or creeping plants adopted by the architects of Egypt, and forming the first *elements* of the Corinthian and composite orders.

It is true that there is a deficiency in the portico of Doric columns at Beni Hassan. But if the metopes and triglyphs appertaining to the perfect Doric style be wanting, oval metopes (adopted as mysterious emblems under the name of *vesica piscis*, by the monastic architects of the earliest Christian eras, alternating with triglyphs,

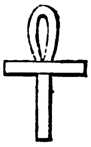


are found on the entablatures of the most ancient rock-hewn temples of Nubia, also at Esueh; while Dendereh exhibits a more elaborate metope, alternating with pentaglyphs,

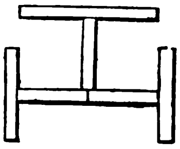


which consists of a Sheckinah, or golden flood of light descending on an ark from between two cherubic serpents (the Urim and Thummim), whose wings are stretched over the ark.

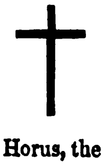
The ground plan of the temples supplies curious matter for remark. As our architects adopt the Christian cross +, so the architects of Egypt adopted the Tau



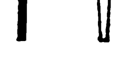
or three limbed cross of Hermes, indication of future life. This ground plan may be traced equally in the palace, the temple detached or troglodyte, and the tomb. The ground plan of the tombs of Lycopolis consists of a series of *taus* mysteriously, as in the freemason's royal arch,



united. The *tau* and *square* united, form the elements of the most elegant of the scrolls called Greek, and borrowed from the Egyptians. In the temples and palaces of New Spain, the Christian cross is adopted for a ground plan, and such a cross is sculptured in the *sacellum* of Palenque. But the Palmer's cross was familiar to the Egyptians,



and often seen in the hands of Horus, the second person of the Trinity. United with the symbol God.



It meant Saviour God. Sir G. Wilkinson says that the Christian Cenobites identified the Egyptian cross with the Christian, and adopted it as a predictive mystery and symbol in their own ritual. It appears among the sculptures of their chapels. It by no means follows, therefore, that the cruciform ground plan of the tombs and temples of New Spain proves the conversion of the builders to Christianity. Both the tau and cross were among the most ancient sacred symbols of Egypt.

The ground plan of Luxore, and the series of obelisks, statues, gateways, and sekoi, so entirely resemble the ground plan and model of the Memnonium, which Champoliion ascribes to Rameses, the father of Sesostris, instead of to Memnon, while he assigns Luxore to Sesostris as the Sesostreum, that the description of the one may almost pass for the description of the other. Karnac, built by successive kings of the same dynasty, exhibits all the peculiarities of the same original ground plan and design in its most highly developed and ambitious character. It may justly bear competition with the troglodyte temple and palace of Ipsambul, which was built by Sesostris, and offers favourable means for comparison between the two styles; that of the detached and that of the rock-hewn temple and palace. We have said before, that the rock-hewn temples and palaces occupy both sides of the valley of the Nile, from Meroe to Syene. The modern localities may be named in succession, Ibrim, Deir, Amada, Sebou, Derri, Garsery, Dukey, Offadooneh, Ipsambul.

The whole series may be described under one category. This holds good as far as regards the larger number of the series of temples, sculptured from the living rock. In a few instances, as at Gorsery, Dukey and Offadoonek, the rock-hewn temple is preceded by propyla, seated statues and sphynxes. In all the instances, the portico of the temple, the naos, pronaos, and holy place are cut from the living rock. There is scarcely any difference in the model. The 4 or 6 cubic pilasters which, in the primitive temples, support the pronaos, in the more elaborate shadows, as at Sebou and Ipsambul, are examples by gigantic caryatides.

The great work of the late Champollion "*Monuments de l'Egypte et de la Nubie*," published, as it will be seen from the title, by a special commission appointed by the French government, under the distinguished auspices of M. Guizot, the present premier of France, and his late colleague, M. Thiers, when minister of public instruction—contains, in its recent number, illustrations of the great architectural monuments of Egypt, when architecture was in the most "high and palmy state" of the 18th dynasty. It is devoted to Ipsambul; but the numbers comprise details of the two structures erected by Sesostris at that place, the Speos of Athor, the goddess Venus, and the Speos, or Sesostreum, cut out of the solid rock, and apparently consecrated to the combined purposes of temple, palace, and tomb. In the temple or Speos of Athor, there is nothing which calls for prolonged commentary. The founder's favourite wife, whom Champollion calls Nofreari, is represented throughout as the presiding divinity of the temple of Venus; in one case apotheosized and worshipped by Sesostris in the character of Athor; in the other associated with him in the presumptuous claim of divinity, he being enthroned by her side in the character of Ammon. Part of a dilapidated statue of Athor appears on the extreme walls of the sacellum of the temple. The figure has a cow's head surmounted by a lotus, and the name Athor, which signifies House or womb of the Sun, the Egyptian Messiah, or Bethshemish, threatened by the prophet "with having a fire lighted in it, which should destroy its images," is clearly visible above the head of the broken and decayed statue. Marks of fire are met with throughout the interior. The antithesis implied by the prophecy between the real fire threatened and the profane fire lighted up within this temple by the orgies of Venus, and the presumptuous deifications of mortal beauties which cover its walls, is obvious and striking. The eighth and ninth folios of the first livraison represent the front elevation of the great Speos of Ipsambul, which, indeed, depicts and records the Titanian ambition of its great founder.

Four of the Caryatides which support the architrave are enormous colossal statues of Sesostris himself, and two of his favourite wife, in the character of Venus or Athor. At the foot of each of his statues stand two of the princes, his sons, and at the foot of each of her's, two of the princesses, her daughters. But the latter do not rise above half the height of the leg of the six colossi which compose the magnificent and unique portico of this astonishing troglodyte palace. On the left side of the portal, Sesostris is sculptured in the act of slaying a vanquished negro, who wears large gold earrings; on the right side he is represented in final conflict with the same chief of the nation of the Robou, whose duel with him is depicted at Luxore. The gigantic character of this *façade* may be appreciated by a glance at the large head lately built up over the doorway of the Gallery of Antiquities, British Museum, which was cast by Mr. C. Smith, from one of the fallen Caryatides. The resemblance of Sesostris to Napoleon is remarkable.

It is our opinion that the Egyptian style might be applied to new buildings of a particular class, as well as to street architecture. We recommend it as being preferable in many respects to Greek, Palladian, or Gothic. We do so looking at it with a view to saving, to applicability, and to capacity. This noble and impressive style of architecture has been too much neglected in this country, although it has been adopted with great advantage in some of the chief cities in the American Union. That it is the incorporation of the sublime and beautiful in architecture no one can deny. But it is also capable of as great elegance, harmony, and beauty as the pure Greek style, by which we mean, not the Roman Greek adopted in our street and sacred architecture, and represented in its high state of improvement by the *chef d'œuvres* of Michael Angelo and Sir C. Wren, but the pure Greek style distinguished by its peculiar characteristics of the barn shaped cella, portico and peristyle. The Egyptian style, in its severer characteristics, is equally well calculated for churches and for palaces, for lordly mansions and for prisons. Again, nothing can be better calculated for cemeteries, piers, lighthouses and quays. It has the special merit of being eminently economical. With regard to ecclesiastical architecture, the lantern spire of those churches which have been lately built on the Greek model, is an invention of modern times, as a substitute for the towers and belfries of the Gothic sacred edifices. In some cases it has been well adapted, in others badly; as in the instances of the Lanthern of Demosthenes, the Temple of the Winds, and the Choragic Monument. Although there be no instance, except the single example of the pavilion we have noticed, of two stories being employed in the Egyptian sacred or palacial structures, and no instance of the addition of a turret or spire, yet it is our opinion that an addition of this description, in conformity with the Egyptian style, might be rendered applicable both to palaces and churches. A steeple supplied to the flat roof of the Egyptian *pronaos* in the form of an obelisk or pyramid would, we apprehend, be a failure; and in proof of this we need look no further than the steeple of All Soul's, in Langham Place, and the pyramidical spire of St. George's, Bloomsbury. But architectural ingenuity would conquer the difficulty; and it must be recollected that the imposing façade of an Egyptian temple was in all cases grandly associated with lofty towers of truncated pyramids; towers which, beyond a question, originated the belfries of the Eastern Christian churches, and the minarets of the Turkish mosque.

These few concluding suggestions are neither uninteresting nor unimportant at the present time, when a city of palaces has succeeded, as if by magic, a congregation of narrow and squalid streets. The result is in every respect good, whether we look to mere gratification, or to the improvement, by the diffusion of good models, of the public taste, so intimately connected with the arts of design, on which our manufacturing prosperity depends.

E. C.

THE EASTERN PENITENTIARY OF THE STATE OF PENNSYLVANIA.

(Designed and executed by John Haviland, Esq., *Architect.)*

This admirable specimen of prison architecture is situated in the North-western environs of Philadelphia, about two miles from the centre of the city, it occupies an elevated site near the river Schuylkill, and presents one of the noblest, and most commanding architectural objects in the country. It was commenced in the year 1822, and completed in 1837, at an expense of 600,000 dollars.

The principal front is 670 feet in length, and is wholly composed of finely wrought granite, accurately jointed, and employed in unusually large masses.

The character of the composition is strikingly appropriate to the objects of the building; its bold and massy features, its broad lights and deep shadows, its well proportioned and well managed openings, and the expressive unity of design which characterizes the whole, produce on the mind of the spectator a most solemn and impressive effect.

The entire façade is *castellated*, and its embellishments are in the "early pointed," or "lancet" style of English Gothic. The gate of entrance, which occupies the centre of the front, is 15 feet wide by 27 feet high; the upper portion of it is secured with a massive wrought iron port-cullis, and the lower part with immense oaken gates, studded with projecting iron rivets; the jambs of the opening are strengthened by massy buttresses, which at the same time, impart a bold architectural effect to the composition.

On either side of the entrance a square tower is constructed, of 50 feet in height, crowned with an embattled parapet, supported by pointed arches springing from corbels. These towers define the extent of the centre building, which is about 200 feet, and their projection from the face of the main wall is 10 feet. The curtain between the towers is also embattled, and its height from the ground is 41 feet.

The extremities of the front are finished with octagonal towers pierced with loop-holes and pointed windows, and crowned with embattled parapets; and a massy octagonal tower rises out of the centre of the front to the height of 80 feet, thus forming a picturesque termination to the group.

The outside walls are 30 feet in height, 12 feet thick at the base, and 640 feet in length on each side, thus enclosing a space equal to about *ten* acres.

The cells are built in *seven* blocks or ranges, radiating from seven sides of an octagonal building of 40 feet in diameter, situated in the centre of the enclosure. The cells of each block are built on either side of a spacious corridor, and these corridors all lead to the centre building, thus affording a view of every cell door in the whole establishment from one and the same point of sight. The upper part of the centre building constitutes an observatory, from which a complete supervision may be had over the entire enclosure; and the lower part, or cellar, contains a reservoir for supplying the establishment with water.

The whole number of separate cells contained in the *seven* ranges, amounts to 844. The three blocks which were first erected are but one story in height, and to each cell is attached a separate yard of 18 feet long by 8 feet wide, surrounded by a wall of 12 feet in height: these enclosures were intended as airing yards for the prisoners, but it has been found, by experience, that the ample dimensions of the cells, and their perfect ventilation, render it unnecessary to remove the prisoners *at any time* from their cells, except in case of sickness; hence, in the four ranges which were subsequently erected, the yards have been omitted, and the cells made two stories in height. The second stories are approached by means of galleries extending along the corridors, supported by cast iron brackets; the stairs, and the balustrading on the galleries are also composed of cast iron.

The cells of the different blocks, or ranges, differ in dimensions, the smallest being 11 feet 9 inches long by 7 feet 6 inches wide, and the largest, 14 feet 9 inches long by 9 feet wide. Each cell has a separate hydrant, a water closet, an aperture for admitting pure air, and a flue for ventilation.

The whole prison is warmed on Perkins' plan of hot water circulation through iron pipes, and those who have the management of the institution seem to be satisfied that the plan is a good one for such an establishment.

The front building, through which the prison is entered, contains, on the right of the gate-way, commodious apartments for the Warden, and chambers for the meetings of the Inspectors. On the left are the clerks' offices, and the rooms of the deputy keepers. Over the entrance, on the second floor, are the apothecary's apartments, and in the left wing, the infirmary.

A high degree of architectural taste and skill is evinced in the whole design of this noble and costly structure, while the beauty and solidity of its execution are equally creditable to its accomplished and tasteful architect, John Haviland, Esq., whose name it is destined to transmit with honour and renown to after ages.—*Franklin Journal.*

ON DREDGING BARS OF RIVERS.

By A. C. Jones, Engineer.

Having seen in the American newspapers several projects for deepening the water, or removing the bars at the passes of the Mississippi river, I am induced to give a sketch of what was done by the United States steam dredger Balize, as I am firmly convinced that the only feasible plan for improving the passes is by dredging. First removing all the lumps in the ship channel, and then deepening the bar by carrying it away as raised. It is idle to talk of damming, ploughing, or dragging, as these projects would never enter the brain of any person that was conversant with the difficulties to be encountered.

An impression exists that the bars consist of soft mud, and are easily removed. This is erroneous, for the bars are hard, and studded with mud lumps, which are forced by some subterranean agency through the bottom, and up sometimes as high as ten feet above the surface of the water. These lump consists of a compact clay (alumine,) of the consistence of cheese, and the surface receives a fine polish when cut with a sharp knife. The action of the water has very little effect on the lumps, (some have perpendicular sides,) except during severe storms, when the tops are washed off to the surface of the water. When the surface is slightly inclined, it is generally covered with innumerable clay pebbles, the fragments of the lumps taking that form by the action of waves on them.

For a perfect understanding, I will give a short history of the Dredger from her commencement. The boat was built by John Vaughan, at Kensington, in a substantial manner, and the engine and dredge machinery, by Messrs. Levi Morris and Co.;* all being fair specimens of Philadelphia workmanship. The whole being under the immediate direction of Captain Andrew Talcott, United States corps of Engineers. The machinery for one side being so far completed as to make a partial trial in the dock; all bidding fair to perform well. The boat was hurried off in the early part of January, 1838, before the full completion of her machinery, through fear of being detained by ice. The Balize did not prove to be a good sea boat, owing to the peculiar distribution of the machinery on board, and in consequence of the roughness of the sea, caused considerable rolling; the boilers being cylindrical, and on the guards, at times, it was difficult to keep the water at the proper height. I found great benefit in knowing the level of the water, by the use of my gauge tube, as described in the Journal; the ordinary gauge cocks giving incorrect results, especially when foaming. The boat drawing nearly two feet more water than her proper draught, made the passage long.

I may mention here that I found the carbonate of lime in the boilers increase in quantity, in a given time, as we proceeded South, although the precaution of cleansing the boilers at the stopping places, and constant blowing, was strictly attended to during the voyage.

On the arrival of the boat at the North East pass, it, and all the force, was put in requisition to assist the corps of engineers in the survey which was then going on; and it was late in the season before all the necessary fixtures were completed to commence dredging. After several trials, it was found that the chain being part of cast iron, (although proved to a strain of twenty-seven tons, at Philadelphia,) frequently broke, owing to the hardness of the bottom, coupled with the great size of the buckets, the contents of each being one cubic yard. New chains were immediately ordered, but owing to shipwreck, and other causes, the chain for one side, although first made, did not arrive until eight months after. On the receipt of chains for one side, numerous experiments were tried at different parts of the bar, perfecting the machinery, and drilling the men. In November, orders were received to proceed with the dredger to Red river, to remove a bar at the mouth of the Chute—prior to our arrival, the pent up water had cut a channel of sufficient depth. The only obstacle was an island of mud, 140 feet long, and 50 feet at its greatest breadth; the whole being two feet above the surface of the water. The dredger was moored alongside, and operated on it with the buckets of one side, and in 23 working hours, one-half of the island was removed down to 13 feet water. As the particles of mud were only carried away by the current, the same mud was raised by the buckets several times, and as many of them came up heaped, so as to contain two cubic yards, it was computed that the dredge raised the enormous quantity of 600 cubic yards per hour,† which is far surpassing any other machine in the world.

The Balize then removed back to her station, at the North East Pass, and proceeded to cut away a mud island, or lump, standing in the centre of the main channel, at the mouth of the Pass. The weather being stormy, the sea forced us to abandon the lump, after making several partial days work on it, and we then operated at the head of the bar proper, which extends five-eighths of a mile from the sea; this enabled us to work in smoother water. The bar being formed of alternate strata of sand and deposit from the river, making the bottom hard; and as the buckets were designed for soft mud, their size prevented their acting well—but with this disadvantage, 1500 cubic yards have been conveyed away by the hoppers, without extra exertions, in eight hours working.

On the 5th of March, we again moored alongside of the island which we previously worked on, and commenced working actively at it, when the sea would permit. The subduing it was necessarily a slow operation, its size being about 350 feet by 150, at its greatest breadth; the top being almost at the surface of the water, with nearly perpendicular sides. The dredge was a long time cutting at it with the buckets of one side before any mud could be raised by those of the other side, to be conveyed away by the hoppers.

On the 5th of April we had cut and removed nearly half of the lump down to 13 feet water, the boat was then shifted to the north side of it, and on the 12th the dredger (drawing 8 feet water) passed over the top of the lump, operating with both sides and filling two hoppers at the same time.

On the 17th of April, 1839, orders were received to stop dredging and lay the fleet up, the appropriation being expended. A few thousand dollars more would have removed this lump from the channel, as the smoothness of the sea at this season of the year admitted of nearly constant working—subsequently the fleet was ordered to Mobile and there laid up.

The principal difficulties encountered in our operations were, 1st, in placing the machinery from the want of correct knowledge of the bottom—for although several partial surveys had been made by different persons from 1820 down, and inquiries from shipmasters and others supposed to be conversant with the actual state of the bars, yet their reports left the impression that the north east bar was soft mud and easily removed; as this proved to be incorrect, the consequence was that numerous alterations had to be made as experience pointed out.

2nd. The operations being on the margin of the Gulf of Mexico, great loss of time was experienced from the prevalence of easterly gales, which blowing against the current of the river caused considerable sea, the depth of cutting being from 13 to 15 feet, the force of the sea had a great effect in deranging the machinery.

3rd. In conveying the mud away from the dredger often considerable time was lost by the hoppers not discharging their load (100 cubic yards) owing to the mass becoming compact.

A great loss of working time was also owing to the tow boat frequently getting aground and blundering in bringing the receiving vessels to, and taking them from, the dredger, all these, coupled with the general inexperience attending works of this kind and magnitude, and being distant over 100 miles from the nearest workshops, prevented a successful beginning; but the latter part of the operation, owing to the perfection arising from practice, was highly successful, and will bear a comparison with any other dredging operation.

In connexion with the foregoing, I give you the mean of a number of experiments made with the engine at Mobile, during the month of June, 1839, these may be relied on as correct, although differing from some of the theoretical properties of expansion. I was unable to give higher speeds to the wheels on account of bringing home the anchors, the boat being moored in the stream.

The horizontal cylinder is 19⅛ inches in diameter, and 7 feet stroke, and works either by a whole stroke eccentric or a ⅝ cam, the exhaust either way being the whole stroke. Each wheel is of the double form, 18 feet 7 inches in diameter; extreme length of the bucket 6 feet 10 inches; each section has 12 buckets 21 inches deep.

The shaft has two fly wheels and couplings to admit of the engine being worked independent of the wheels.

The time for experimenting was chosen when there was little or no current, the engine being in perfect order, and working with little friction.

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* As a proof of the excellence of the workmanship of the engine, I will give *one* example. When I left the boat, the key of the connecting rod, at the cross head end, remained as driven when steam was first applied to the engine, it not having been required to alter it.

* That there may be no doubt of this, I will state that eight buckets were raised per minute.

8 × 1 × 60 = 480 cubic yards, even measure. The buckets being kept heaped, 600 yards is a safe estimate.

One pair of boilers were used, these being on the guard made the length of the steam pipe about 13 feet, it and the cylinder being covered so as to lessen the radiation of heat. At the time of the experiments the boat had a list to port, which made the immersion of the starboard buckets two and a half inches, and the larboard ones seven inches. The pressure in the boilers being one and a half pounds to the square inch, the throttle valve being open (during the experiments,) and the whole stroke on, just kept the engine in motion, being equal to the friction.

Pressure in the boiler, lb. per square inch.	Steam as applied.	Revolutions per minute.	Remarks.
6	Cam.	7·5	Engine alone
6	Eccentric.	18·5	
5	Cam.	None.	
5	Eccentric.	12	
4·4	"	Just move.	Starboard wheel coupled.
6·4	"	"	Larboard.
10·4	"	"	Both wheels.
13·5	"	3·3	"
20·4	Cam.	Just move.	"
24·4	"	6	"
24·4	Eccentric.	9·5	"

I also verified the experiments noted in this journal, to prove that the water displaced by steamboat wheels did not come from before them. I strewed the surface of the water with chaff and then set the wheels in motion, and found that six inches in front of the wheels the chaff floated undisturbed.—*Franklin Journal.*

EXPLOSION OF A STEAM BOILER AT MANCHESTER.

In the beginning of the month of October last, an awful occurrence took place through the bursting of the boiler of a steam engine, at the factory of Messrs. Elce & Cottam, in Jersey Street, Manchester, which occasioned the death of nine individuals working at the factory. An inquest was held upon the bodies before James Chapman, Esq., the coroner for the borough of Manchester, who has very kindly furnished us with a copy of the depositions, from which we now extract the most important part; the inquest was held on the 14th day of October last, and was adjourned until the 5th day of November, for the purpose of allowing competent parties to examine into the cause of the accident.

Steward Sands was examined. He stated that he is a pattern maker, and had much experience in the working of steam engines, and has been in the employ of Messrs. Elce and Cottam for the last nine months. The engine was a six horse power high pressure engine, and was an old one; the boiler was cylindrical, with *egged* (flat) ends of wrought iron, three eighths of an inch in thickness, and stayed from end to end by an iron rod passing through it, and cottered at each end. He thought the boiler had been overweighted from the quantity of machinery the engine had to move. The engine had not started, as he was going into the yard, to any work; but the safety valve attached to the boiler would be weighted for the machinery it had to put in motion during the day; this was too much, and caused it to burst. On the first floor there were two grinding stones, seven lathes, a drilling machine, a smith's bellows, and a boring apparatus for head stocks. On the second floor were one small grinding stone, six lathes, a planing machine four feet long, a centreing machine, and a wheel-cutting machine. In the third floor there was a roving or jack frame containing 72 spindles. With the exception of the centring machine, all had been at work up to six o'clock the previous afternoon, and had been turned by the engine. The roving frame, which started about a fortnight ago, worked only at intervals. It had been at work the day before the accident from three in the afternoon until six, and it was intended to be worked with the others the following day. The boiler was 3ft. 6in. in diameter, but he could not speak to its length, and was in good condition and well calculated to work an engine of six horse power, but no more. The cylinder was eight inch bore, and two feet stroke. For this engine thirty pounds to the square inch was sufficient, and from the quantity of turning that had to be done, he thought the engine was overworked. It would take three or four horses power more to perform the work the engine had to do. When the engine is not overweighted, it goes so freely that its motion is not heard, but when it is overweighted it goes stiffly, and makes a loud hissing noise. He perceived, for the last three months, by those signs, that the engine was overweighted. He thinks it will take two horses power to drive the jack frame. He knew Edward Allen, the late foreman. He is quite sure the engine and boiler were overweighted by about three or four horses power the evening before the accident. Yesterday, about half past three in the afternoon, I told Mr. Elce that the engine had been overworked; he said he thought not before the jack frame had been put on. Sands said "You must know it was overweighted;" and Mr. Elce replied, it was not overweighted, but he thought the jackframe was more than what it was calculated to work.

John Lee, of Manchester, machine maker, was examined. He stated that he had much experience in engines and boilers. Saw the premises immediately after the accident, and since the boiler was found, and has examined it and the ruins, in order to ascertain the cause of the accident. He first thought that the boiler had been short of water, and that by pumping cold water upon the heated plates, it had generated some elastic force very suddenly, so as to cause explosion; but on enquiry, he found that the engine had not started that morning. Boilers oftener burst at starting than afterwards. If there was too much steam in the boiler, or if it was overloaded, if the pressure had been gradually generated, and the valve was not fast, danger would not ensue; but if suddenly generated, or the valve fast, explosion would take place; the valve was of sufficient size to carry off the steam in case of over pressure. He thought from the first that the valve was not fast, because the first projectile force was given through the safety valve, which threw the blowpipe across the two yards, a distance of 160 feet, and forced the same six inches into the brick embankment, and from an examination of the valve since, he was of the same opinion. He found the valve in good order, but the valve rod was bent in consequence of being thrown from the boiler at the time of the explosion. He got the rod straightened, took off the gland, and found inside a greasy substance, and the packing was in good order. From this he concluded that the valve had not been neglected. He thinks the boiler was sufficiently strong, the plates being thicker than those he had seen in boilers for a similar purpose. His opinion is that the stay rod was not sufficient to counteract any sudden expansion of the steam, but it is such as is generally made and in use at the present time. It would have been better had there been more stay rods. He thought the link to which it had been attached to the back end, being the one first found, was defective, the same having been bent the wrong way of the iron; had it been bent the right way, it is possible the explosion would not have taken place; the shell of the boiler he conceives to be as good now as when it first came out of the maker's hands. He was of opinion that the plates had never been red hot. It was not possible for explosion to have taken place in case of the plates becoming red hot, unless (?) cold water had been poured upon them, which could not have been the case in this instance, as the pump had not been worked that morning, the engine not having started. He could not speak with certainty whether, if there had not been sufficient water in the boiler, and the boiler had become heated, the effect upon the water would be such as to create explosion before the safety valve could be acted upon. It is the opinion of some that decomposition of water in a close vessel by heat creates hydrogen, but that could not explode without an admixture of oxygen, and not even then until it was ignited; were it possible for this effect to take place, all the safety valves that could be affixed could not have prevented explosion. He could not risk an opinion as to what has been the cause of the explosion in this case; it must have been from sudden expansion, but how originating he could not tell. If such explosion had taken place at the stopping of the engine instead of the starting, he should not have felt so much astonished, as engines are repeatedly stopped when the steam is up at the full pressure, which must throw the elastic force instantaneously into the boiler; but in doing this, he has never known explosion to take place. He does not think there is more danger in high pressure than in low pressure boilers, provided they are properly attended to, because, from observation, he conceives that the majority of explosions have been from low pressure boilers. He does not think that any additional valve was necessary in this case, but a second valve is certainly better. He has frequently been on Messrs. Elce & Co.'s premises, and from what he has seen, and their general mode of conducting business, he does not think there is any blame attributable to them. He has measured the boiler. It is 3ft. 11in. in diameter by 9ft. 6in. long, being round, and having flat ends, and was capable of working from 7 to 8 horses power. The apparatus attached for indicating the pressure were, a safety valve at the top, with a lever attached to a Salter's balance, which indicated the pressure per inch by figures engraved on the face of it, and a glass gauge in front indicating the height of the steam (water?) but these, except the safety valve, he has not seen as they were destroyed by the explosion; there were also two pipes with taps at the ends inserted at the top of the boiler, the one for steam, the other for water; if the boiler was short of water, the latter so being opened would allow the steam to escape, which would be a sufficient indication that the boiler wanted water. He thinks these, if in good order, were quite sufficient, and from inquiries he has made, they were in good order. If cold water had been thrown in amongst the steam whilst the water was boiling, the boiler would have collapsed. There is no such appearance about it now. If upon the plates when hot, it would create expansion (? contraction)—there were no such appearances about the boiler when pulled out of the canal; the back end of the boiler is protruded about six inches, owing to the stay rod having given way; the stay rod has lately been found, from which he was satisfied that the boiler had flat ends. Such a boiler is not so strong as one with egged ends, but still it was sufficient for a seven or eight horse power engine.

George Branson, of Manchester, engineer, stated that he was on Messrs. Elce & Cottam's premises on the 8th of October, and observed the same so as to be able to speak particularly to the whole of the machinery. He saw the boiler at the same time, and has seen it since the explosion. He thought it a good one, and he is still of the same opinion, and the body of it has not gone out of circle the eighth of an inch. He thinks the accident was not owing to pressure from steam, but the hydrogen and oxygen gases coming into contact with the red hot plates of the boiler; if the water was boiled down lower than where the fire acts upon the boiler, the plates of the boiler would then become red hot, and would change the water into hydrogen and oxygen, the iron would take up a portion of the oxygen, and the hydrogen would then be in the space of the boiler, and explosion would take place without the presence of atmospheric air from without. I come to this opinion, not from my own experiments, but from having seen the electric spark applied when the vessel has been hermetically sealed, by means of a wire being passed into it, and in this case the heat from the fire would, in like manner, pass through the iron plate, but it could not have passed if there had been water inside. He has known explosions to take place from low as well as high pressure boilers, where parties had professed to work with only four pounds to the square inch; we very frequently work low pressure boilers with only three pounds to the inch, but not where explosions have taken place. I think such a stay rod was sufficient for this boiler, and that there was no more than five and a half horses power on the engine when all the machinery was at work in the usual way; there were on the premises thirteen common lathes, which would take two and three-fifths horse power; two slide lathes, half horse power; one large grindstone, which was worn down, one half horse power; two small ones, a third of a horse power; one upright drill, one fifth of a horse power; a planing machine four feet upon the bed, one fifth of a horse power; a centring machine and cutting engine, a fifth of a horse power, because both could not be employed together; a roving frame with 72 spindles, a fifth of a horse power; and an eccentric machine for blowing a smith's bellows, a tenth of a horse power, or half a man. He has had much experience in fitting up mills for the last 14 years, and he has always proceeded and disposed of the power in this ratio. If the gauges were defective, the water might get too low without the engineer observing it, but it was more likely to be owing to the negligence of the engineer, as he has often found them negligent, even when they have been short of water, and water could not be forced into the boiler, the steam being so high. The machine and tool work were all light.

Robert Armstrong, of Salford, engineer, was examined. He stated that he had examined the boiler since it was found, and should not like to have trusted it with a pressure of 40lb. to the square inch, but for the quantity of machinery to be turned, there was no occasion for any such weight; he knew of many in the town egg-ended without stays, to work with 40lb. This might be worked with 30lb. without danger; such a boiler was sufficient to work an engine of from 6 to 10 horse power. He considered the accident arose from the water getting too low, and too much steam rising too rapidly, the water rising over the heated plates, and being suddenly flushed into steam with great pressure; there are marks inside the boiler which show that the water had frequently been allowed to get too low, so as to allow the plates to get overheated above the surface of the water, but could not speak positively to this having been the case in this instance; had it been so, and had the boiler been ten times the strength it was, it would have exploded. All high pressure engines, from the mode in which they are fed with water, are liable to such accidents. This boiler was too little for 10, but it would drive from 6 to 8 horse power very well.

Thomas Banks, of Manchester, engineer, stated he did not make either the engine or the boiler. About 16 months ago he put a Salter's spring to the boiler and weighed it to forty pounds. Mr. Elce was very anxious to prevent accidents, and since this Mr. Elce has got a waterfloat, which he always considered the most dangerous thing about boilers, more accidents having happened through them than anything ever appended to boilers, as I have proved from an experience of near fifty years; they are very useful if attended to, but the engineer must not depend upon them too long; they cause the engineer to be over confident. Two good gauge cocks, a Salter's spring, and a safety valve, which this boiler had, were sufficient in any case. He had no doubt if Mr. Elce had never got the waterfloat, the accident would never have happened; he also put up a steam gauge. He thinks if the engine had been weighted for nine or ten horse power it would have broken down, but the boiler would have stood. He thinks the explosion was owing to the boiler being short of water. He has known of many explosions, all of which he attributed to the same cause.

George Watson Buck, of Ardwick, and *William Fairbairn*, and *Richard Roberts*, of Manchester, engineers, gave their evidence jointly; they stated that they had examined Messrs. Elce and Co.'s premises, for the purpose of endeavouring to ascertain the origin of the bursting of their steam boiler. The engine was on the high pressure now condensing principle, and called a six horse power; the boiler was cylindrical, measuring 3ft. 10½in. internal diameter, and 9ft. 4½in. long, with flat ends; each end was composed of two semicircular plates rivetted together in the centre, in the direction of its horizontal diameter: the ends being of this weak form were sustained or strengthened by a tie bar passed through the centre of the boiler, and connected by cotters or keys to staples or stay bar straps of iron rivetted to the centre of each end; the part which first gave way, we think, on close examination, was the staple to which the tie bar was keyed at the end next the furnace; that the key or cotter had been driven until its larger end was in contact with only one inch in length of the staple, and that the pressure of the steam was then sufficient to draw the cotter through the plate of which the staple was made; the staple and the cotter indicate that this effect must have taken place after the tie bar was thus liberated, either end of the boiler might next give way, but it appeared that the opposite end being accidentally the weaker of the two, which it must have been, (probably from its being more subjected to the action of the hot air of the flue), then gave way, being torn asunder horizontally at the rivets; the two halves of the end then flew open like folding doors, and detached themselves from the boiler by breaking the angle iron to which they were rivetted; at the same moment the cylindrical part of the boiler, with its other end, was projected horizontally with prodigious force, its end came in contact with a heap of coals and the earth, which was scooped out to the depth of two feet, lying in its path, by which the other flat end of the boiler was driven into the cylindrical part where it was afterwards found. This obstruction of the coal and brick wall against which it was lying, and also of the earth, changed the direction of the motion of the boiler, and deflected it into the canal where it was afterwards recovered. The boiler did not appear to have suffered injury in any other part from the explosion; we observed that the safety valve was loaded by means of a vertical rod passing through a stuffing box, and this rod we were informed was acted upon by a lever and spring balance of Salter's construction, and that it was capable of being screwed down to a pressure of 45 lb. to the square inch, and no more; on examining the vertical rod attached to the valve, they were led to conclude that it appeared to have been set fast, or that it must have offered much resistance to the rise of the valve independently of the pressure of the lever, from the following considerations. If at the moment of the explosion the pressure of the steam had exerted a force of only 45 lb. to the square inch, or the maximum according to the spring balance, the strain upon the tie bar would have been about 25,500 lb, but the force exerted to draw the cotter through the staple, on the supposition that the metal was of average strength, must have been about 57,000 lb., which indicates that the expansive force of the steam must have amounted to not less than 100 lb. per square inch; this they believe was the real cause of the accident, but whether the valve was held down accidentally or intentionally, in all probability can never be known. They think that the ends of boilers of this description for high pressure steam should be convex instead of flat, and that the safety valve should be so constructed as to be acted upon by the weight or spring without the intervention of a stuffing box or any other obstruction, between it and the lever spring or weight acting upon it, and that although injudiciously loaded, the boiler would not give way for steam at a pressure of not more than 45 lb. to the square inch, but that it would have been better had there been several stay rods or tie bars instead of one, and that no accident would have happened had the above precautions been adopted; that they could see nothing in connexion with the death of the deceased for which any one could be chargeable with blame, except only that it was injudicious to depend upon one tie bar, and they have no reason to believe that there was an insufficiency of water; and that from 5 to 5½ horse power would turn all the machinery except the jack frame, which we cannot speak to; the accident we attributed to the valve, which they consider did not act from some cause unknown, although it might be in good working condition.

The Hannibal.—The keel of a 90 gun ship, to be named the Hannibal, has been laid in the same spot where the Trafalgar was built in Woolwich Dockyard, and a number of workmen are actively employed in preparing the timber for her construction. The Hannibal will be a splendid vessel on Sir William Symond's plan, and have a great breadth of beam, for which vessels designed by the present surveyors of the navy are distinguished.

The following are the dimensions of the Hannibal:—

	ft.	in.
Length on the gun-deck	204	0
Breadth extreme	60	0
Ditto for tonnage	39	2
Ditto moulded	38	4
Depth in hold	23	8

INSTRUCTION IN DESIGN, AND SCHOOLS IN THE SEVENTEENTH AND EIGHTEENTH CENTURY.

Great as the outcry has been of late with regard to schools of design, the plan is by no means new to the metropolis. At the latter end of the seventeenth century, while what we may call the mechanical portion of art was still flourishing, the symptoms of decay were apparent; and a little later, the general introduction of composition ornaments caused a rapid decline. The foundation of the school of drawing in Christ's Hospital is perhaps the first instance of the recognition of design as an essential part of useful education; and it is surprising that it had not a more extensive influence. About the commencement of the eighteenth century, when Strype published his edition of Stow's Survey, the overthrow of the lower branches of art may be considered as complete; and we find Mr. B. Lens exerting himself to produce a better state of affairs. His arguments, published by Strype, are quite identical with those which have been lately urged; and it will perhaps afford some gratification to extract at length Strype's account of his school. (vol. I. p. 173.)

"Another school for drawing, limning, and painting, set up anno 1677, by one Mr. B. Lens, now or late living in Fleet-street, an art exceedingly useful for all sorts of people, as for gentlemen that travel, * * and for tradesmen; such as are concerned in building, as masons, carpenters, joiners, painters, and the like. The professor of this art teacheth on Tuesdays, Thursdays, and Saturdays, in the morning from 8 to 11, and on Mondays, Wednesdays, and Fridays, in the evening, from 6 to 9; the price, a guinea entrance, and a guinea a month. * * He hath very well set forth the general usefulness of this art by a printed paper, which may deserve to be here inserted. *Graphice*, by Aristotle is generally taken for the art of drawing anything (Γραφικε) whatsoever, with the pen or pencil, and was reckoned among the chiefest of those his παιδευματα, or generous practices of youth, as rendering them so many ways serviceable to their country, and profitable to themselves. Of incredible service and advantage it would be to our smiths of all sorts, masons, bricklayers, carpenters, joiners, carvers, turners, embroiderers, tapestry-workers, silversmiths, jewellers, nay, to all our handicrafts in general. For, show most of the workmen abovesaid a draught of what you would have done, their want of skill in drawing renders it almost useless to them. For example, should an engineer invent a machine, and draw it in all its parts, with its views per front and sides, the whole in perspective, a ground-plot thereof, with a scale annexed thereto; with what difficulty do they work, and the projector must be always by, or all will be marred: whereas, could our handicrafts and mechanics draw, a man might send his work from a hundred miles' distance, drawn as abovesaid, and be satisfied it would be performed to his mind, and according to his directions. By what has been said, I would not have it thought that none of our handicrafts and mechanics can draw, for some do, of my knowledge, very well; which qualification hath made them the most excellent of all others, for the best draughtsman will be the best artist, in what art soever. The design of this school is to have a constant nursery or breed of youths proper for artificers. * * For proof of what hath been said, discourse with the meanest of all our handicrafts, though he cannot draw, yet will endeavour to chalk out, after his fashion, your meaning and his; knowing by pure instinct, that all the rhetoric in the world cannot convince like a drawing. * * If parents sent their children to drawing, as customarily they do to Latin and writing, it being altogether as useful to them, they would soon find the advantage themselves, and their children would reap thereby; for a master would take a servant qualified with drawing with half the money, and be a gainer thereby, for the boy would come to work in half the time." * *

That Mr. Lens's intention was a good one, there can be no doubt; but whether in making a charge of twelve guineas a year he made his school acceptable to the working classes, admits of great question. As being a labourer in the cause of public instruction, he is, nevertheless, entitled to much praise, although the time was so unfavourable to a successful issue of his attempt. Mr. Lens was also a private teacher, and afterwards became drawing master in Christ's Hospital.

OBSERVATIONS UPON THE COMPARATIVE ADVANTAGES AND INCONVENIENCES OF THE EMPLOYMENT OF IRON WIRE, OR BAR IRON, IN THE CONSTRUCTION OF SUSPENSION BRIDGES OF GREAT SPAN.

By M. Le Blanc, Chief Engineer of Bridges and Roads.

*(Translated from the French.)**

Cables of iron wire, and chains composed of bars of wrought iron, may be compared with reference to their economy and their durability.

As regards economy, the question scarcely deserves discussion, and it is easy to prove *à priori* that, in all possible cases, iron wire has the advantage over wrought iron.

In fact, the Council of the *Ponts et Chausees* has adopted the principle, that cables of iron wire should be submitted to a tension of 12 kilogrammes (26½ lb.) per square millimetre (·0016 square inches) of section; but for bar iron, it was decided that the maximum of tension shall not exceed 8 kilogrammes (17·6 lb. nearly).

This principle is founded upon the comparative resistances of iron wire, No. 18, ordinarily employed in the construction of cables, and of iron bars 3 to 6 centrimetres (1·2 to 2·4 inches) in diameter.

The natural consequence of this principle is, that the section of a chain should be greater by one half than that of a cable, for the same tension; this involves a proportional increase of its weight. In cables of iron wire no joints are used, or at most, but a single one, as in the bridge of Argentat, and this joint made up of two small eyes, weighs but little—on the contrary, they are numerous in chains, and where the system is rather complicated, as I shall prove it should be in bridges of great span, each one of these joints weighs at least 140 kilogrammes (309 lb.). On the supposition that the suspension rods are 1·2 metre apart (47¼ inches), as there is a joint for each rod, there will be 233 kilogrammes (514 lb. nearly) for a bridge of 180 metres (590 ft.) span. This additional weight, together with that of the bars themselves, which, as we have just seen, is one half greater than that of the cables, produces an excess of tension which must again be resisted, whence there arises a new increase of section, and consequently of weight in the chains. In applying these principles to individual cases, it is found that the weight of the unit of length of a system of chains exceeds double that of a system of cables.† Now, as the price of iron wire is once and a half that of bar iron, it is plain that the use of iron wire is more economical than that of wrought iron.

I have proved that the total tension is much greater when chains are used, it follows that greater strength must be given to the moorings and to the intermediate piers, when the bridges have several openings or bays—a new cause of increase of expense.‡

It appears to us to have been thus thoroughly proved, that in regard to economy, the cables of iron wire are superior to chains of wrought iron.

Let us now compare the two systems in relation to their durability.

The principal objections which have been made to the employment of iron wires are the following:

1st. They offer greater chances for rapid oxidation.

2nd. The imperfection of the present process for manufacturing the cables does not allow us to give an equal tension to all the wires, so that when the cables are raised to their places, the wires which are under most tension have to support many pounds in excess—while those under least tension do not draw at all.

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* We are indebted for the translation to the American Railroad Journal.—Editor.

† In the comparative proposals which I presented for the bridge of Roche Bernard, I showed that these weights are in the proportion of 11 to 25; in order to replace 11 kilogrammes (24 lb.) of iron wire, which at 1f. 50c. cost 16 francs, 50 cen., we must employ 25 kilogrammes (55 lb.) of wrought iron with 25 francs.

‡ In bridges of several bays the cables or chains should be fixed to the intermediate piers, in order to avoid the great changes of form which result from unequal loads upon the two bays, if the chains and cables can slide freely over the top of the piers. Because these piers have to resist only the difference of the tractions produced by different additional loads upon the two bays, it would appear at first sight a matter of indifference whether the permanent loads which are in equilibrio are greater or less; nevertheless it is plain that the less these permanent loads are, the better the piers are in condition to resist the maximum load of one bay, the other being destroyed: it is, then, not unimportant that we diminish the permanent load as much as possible.

3rd. Cables form a system less rigid than chains of wrought iron do, so that the horizontal oscillations of the roadway are more considerable in the former than in the latter case.

I believe that I have not withheld any of the objections urged against the employment of iron wire, nor weakened those I have presented. I shall now examine them in order.

First objection.—They offer a much greater chance for oxidation.

It is certain that if we expose to alternations of dryness and humidity a bar of iron and a certain number of isolated wires, the sum total of their individual sections being equal to that of the bar, the surface attacked will be far greater in the wires, and in them the oxidation will be most rapid.

In confining ourselves to this general *fact*, without reference to any of the means employed by art for retarding this oxidation, it will be well to examine if even this inconvenience of the more rapid destruction of the cables, is not more than counterbalanced by the advantages which they present.

It is very evident that if the cables remain only forty years without being renewed, while the chains may last for sixty or one hundred years, we must calculate what will be the amount at the end of forty years of the sum saved by the use of iron wire instead of bar iron.

To render this more plain, I will give an example. I suppose that a given suspension bridge requires 200,000 kilogrammes (441,096 lb.) of iron, (which was nearly the quantity for the bridge of Roche Bernard).

The expense of the system of suspensions . . .	300,000 francs.
According to note (1) to replace the iron wire there must be used 454,545 kilogrammes of wrought iron, which would cost	454,545
Saving in favour of iron wire,	154,545 francs.

Now this sum put at interest, will amount at the end of twenty-three years, to 475,506 francs, and supposing that the cables must be entirely renewed at this time, there will still remain a surplus of 175,596 francs, which will be more than sufficient to produce at the end of another twenty-three years, a new capital equal to the cost of the system of suspension.

In the case which we have considered, cables of iron wire lasting but twenty-three years will then be preferable to chains of indefinite duration.

The supposition that isolated wires will last twenty-three years without the necessity of being renewed, is not without foundation—and we shall produce a fact which strongly tends to confirm it.

M. Mongolfier, jun., having learned that a grating of iron wire from the church of St. Martin's at Paris was about being taken down, after having remained forty years without any repair, had the curiosity to prove these wires, after having carefully ascertained their number, and he was convinced that they had lost but one-fifth of their entire strength.*

This loss of strength is not sufficient to require a complete renewal of the system of cables.

But the most determined opponents of the use of iron wire confess that cables do not afford such facilities for oxidation as detached wires. The greasy substance which covers them affords a powerful preventive to rust; their union preserves them in the interior, more or less, from moist air; the ligatures are a still further obstacle to its introduction; and finally, the careful superintendence which should be given, are all reasonable motives for hoping that the effects of oxidation may be diminished in a remarkable manner.

It may be objected that experience has not fully confirmed the opinion, however probable it may be, that cables are less susceptible of the attacks of oxidation than iron wires. I confess that no one fact can as yet, incontestably, prove the justice of this opinion, but there are several which we can produce, capable of giving much strength to it.

The bridge of Tournon has been in existence eleven years, but no very considerable trace of oxidation has manifested itself, at least, to my observation, upon the surface of the cables; and if there existed any in the interior, it would not have failed to show itself by a brownish stain upon the outside of the paint which covers them.

A bridge of iron wire was built at Brest, in 1526; the cables, exposed to the salt air, which attacks iron with so much energy, should have undergone a remarkable deterioration in the space of three years. M. Trotte de la Roche, Chief Engineer, who, on account of the plans adopted for the port, was obliged to dismount it, took the pains, at the invitation of M. Inspector General Lamblardie, to prepare a *process verbal* of the state in which he found the cables.

It appears from the *process verbal*, 1st. That the continuous ligature which covered the cables was slightly attacked, but that by the first scratch of the file, the oxidized portion was removed. 2nd. That the exterior wires of the cables showed slight traces of oxidation, but that the slightest scratch of the file caused them to disappear. (M. Trotte de la Roche supposes that the oxide was only deposited upon the wires of the cables, and that it came from the ligatures.) 3rd. That the interior wires were perfectly untouched.

Eight years is a short space of time, but if we consider that the effects of oxidation probably continue to decrease, we may conclude that they are not so very rapid, and that the fears entertained upon this point are greatly exaggerated.

An observation has been made, which is worthy of remark; it is, that in chains the surface of the bars which is attacked by oxidation proves the portion of them offering the most resistance, while in a cable the interior portions have the same strength with the others.

Second objection.—The imperfection of the present process for manufacturing the cables does not allow of an equal tension in all of the wires, so that when the cable is raised to its place, the wires under most tension are overstrained by many pounds, while those under the least tension do not draw at all.

This last objection is a serious one, and cannot be absolutely done away with, that is to say, it is impossible to prove that this defect does not deserve the most serious attention; but we can employ, in defence of iron wire negative arguments, or in other words we can prove that it is not possible to resolve the problem of equal tension in a more perfect manner by the system of chains than by that of cables of iron wire.

We must, in the first place, distinguish carefully between bridges of large or small span; in the latter, where the tension requires only a section of the chains equal to that of 4 to 8 bars of about 0·05 metres to 0·06 m. (2 to 2½ in.) in diameter,* (dimensions beyond which the quality of the iron becomes considerably deteriorated,) we can establish on each side of the bridge two or four separate chains in one or two layers, each chain being made of a single bar only; in these two cases the problem of equal tension is perfectly resolved, and although in the second each suspension rod bears upon two chains which cannot have exactly the same curvature, the holding plate of the rods will always bear upon the two chains, which will then support equally their share of the whole weight of the bridge.

By establishing three or even four layers, we can form an excellent system of 16 chains, each made of a single bar; but these 16 chains present only a total section of less than 44,000 millimetres (97,041 lb.), corresponding to a tension of 352,000 kilogrammes, (776,329 lb.) that is to say, to bridges of medium span; but if we pass to bridges of such a span that the tension increases to more than a million of kilogrammes, it will be necessary that the chains should be composed of 48 or even 64 bars, that is, 24 or even 32 bars on each side.

Let us consider the last hypothesis, which applies to the case of the bridge of Roche Bernard.

It is impossible to employ the simple system of suspension rods resting upon a couple of chains, of single bars, and arranged in layers, for we would then have 16 of these layers, one above the other, which, beside the inconvenience presented by a considerable height, would allow of the attachment of suspension rods only at every sixteen intervals upon the same chain.

Here then it is necessary to employ a more complicated system, namely to form the chains of several bars fastened together by a single bolt—in this case I would reduce the number of chains to eight, and form them of eight bars, fastened by one bolt.

We can double the number of chains, and so reduce to four the bars in each, by making each rod rest, by means of plates, upon two chains at once, but if the two chains forming the couple are not in the same plane, the upper plate of the rods will bear only upon one of the chains—for it must remain parallel to the plane of the four bars—and one half of the system will support nothing; this disposition is too faulty to be adopted—this is my opinion in the hypothesis of eight bars to each chain and fastened by one bolt.

Whatever may be the manner of forming the eye at the end of the bar, either by welding it to the end itself, or by bending over a portion of the bar, it appears to me very difficult to prevent differences in length of at least a millimetre between the bars.

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* The increase of oxidation is not as rapid as would be supposed from the first observations made—for the first layer of rust which covers the surface of a bar of iron, instead of favouring this oxidation, proves a coating which is an obstacle to it.

* I reason on the supposition of the use of round iron, of which I need not prove the superiority over square iron, that is hammered again after being re-heated to a cherry red.

† I suppose it would not be desirable to employ more than four layers—this number is already considerable and troublesome in the passage over the towers and in the moorings.

Now if there is this difference between bars, 5 metres (16·4 feet) in length, the shortest must lengthen a millimetre, or ·0002 of their length before the others draw.

But we know that a tension of two kilogrammes per square millimetre of section produces upon a bar an elongation of ·0002 of its length.

The bars then of which we are now speaking, are strained to the amount of 4 kilogrammes (9 lb.) (per sq. millimetre) before those beside them suffer any tension; what will this amount to if the differences in length are more than one millimetre?

We see then that the problem of equal tension is as difficult of resolution for a complicated system of chains as for iron cables, for supposing that in the two systems, the excess of tension, either of one wire over another, or of one bar over another, is the same, this excess will be a much smaller fraction of the absolute strength of wire than of bar iron; moreover, the manufacture of cables affords a greater hope of perfection than that of chains.[*]

We see now that the second objection has no more weight than the first, to decide us in favour of wrought iron chains.

On the other hand, there are objections against the employment of bar iron more difficult to remove, and which will give additional strength to the reasons which have induced me to yield the preference to iron cables.

These objections are as follow:

1st. The greater part of chain bridges which have fallen have given way at the bolts which unite the links. Now it is extremely difficult to calculate the strength which should be given to them, as we do not perfectly understand the manner in which they resist the strain; if we compare them to bars placed upon fixed bearing points, and charged with a weight in the middle, and the resistance of which is derived from a formula $P = M\frac{a\,b^2}{2\,c}$ we find the dimensions very small, too small indeed, according to many experiments.

If we suppose them to resist as if drawn in the direction of their length, (and many constructors admit this hypothesis,) we arrive at large sections, which greatly increase the weight of the joint; besides this, we have no certain information as to the quality of the iron which they need; it should not be so soft as that of the chains, because no curvature is required; but still it should not be brittle. To avoid mistakes prejudicial to the durability of the work, it is wise to make them rather too strong than too weak; but as I have just said, an increase of weight is the consequence of this precaution.

2nd. The making of the eye requires great attention; it has been observed, that when the bolt is too little, during the proof, a rent takes place from the outside to the inside of the head of the eye; when the bolt is too large, the rent opens from the inside toward the outside. Now, as it is almost impossible that the work of man should be perfect, in order to avoid the inconvenience above-mentioned, several constructors have proposed to swell out the head of the eye, in order to give it greater strength; but to do this we must re-disturb the particles of iron by hammering after having heated it, an operation which I have already designated as faulty.

3rd. During the oscillatory motions, which take place in all suspension bridges, the irons rub forcibly against each other at all the joints, and this tends to wear them in those parts which have the greatest strain. This inconvenience does not exist in wire cables.

4th. In the moorings we are compelled to use curved irons, which have of course been re-heated, and are most often squared; this new heating, and the difficulty of proving them, obliges us to give a greater size, which involves another increase of expense.

5th. In very cold weather iron becomes brittle; wire enveloped in grease, and not in immediate contact with the air, must be less brittle than naked bars of iron.

6th. Cables in bridges of great span, can be much more easily raised to their places than chains. In the proposal for the bridge of Roche Bernard, I have calculated that the weight of a cable would be 7,968 kilogrammes (17,673 lb.), while each chain would weigh 31,496 (69,462 lb.); a work equally difficult, it may be said, has been executed at the Menai bridge; but if this proves that it is not impossible, it does not prove that it is not very difficult.

M. Vicat has asserted, that wires before breaking, suffer a considerable elongation, which announces the rupture beforehand, and thus gives time to make the necessary repairs, while chains break instantaneously.

This advantage of iron wire has been disputed, in the case of wires united in bundles by ligatures, and the interstices of which are filled by grease. M. Frinot thinks that these bundles form a brittle system; he doubtless would like to say, as brittle as bar iron. In support of his opinion he has cited the *herse*, a sort of skein of hempen thread, which has most strength when its elements are free, and loses part of it as soon as the loose threads are bound together, and approximated to the condition of ropes. If this assertion is confirmed by experiments—and I have prepared some for this purpose—cables will in this point of view, be neither worse nor better than bar iron.[*]

Third objection.—Cables form a less rigid system than bars of wrought iron, so that the horizontal vibrations of the roadway are much greater in the former than in the latter.

For equal curves and weights this is true, but when we have once given the preference, even in point of durability, to wire over bar iron, (and I confess I have done so,) will we not gain more by increasing the rigidity, by means of the greater weight of heavier timbers for the roadway, and by diminishing the curvature of the cables, or the tension which they should bear per square millimetre of section, than by substituting chains for cables?

These latter likewise admit of an arrangement which cannot be adopted for chains. I refer to the cradle form; and in this case the outside cables being in a plane, inclined from the vertical, have a tendency to draw the whole roadway towards them, and as this takes place on both sides, it follows that the roadway is kept in its position better than it would be by means of stays.

I offer these reflections to the readers of the *Annales*, as the result of perfect conviction in my own mind, after deliberate consideration, and I can indulge the hope that this conviction will be shared by at least a small number of my associates. I shall examine in a subsequent article the advantages and inconveniences of a diminution of curvature, and the defects in the proof which chains and cables undergo, either before or after being placed.

Suggestion for the Prevention of Fire in Churches.—A correspondent of *The Times*, remarking upon the frequent occurrence of fires in churches, as well as other old buildings, in which the modern practice of warming by stoves has been introduced in buildings not originally constructed for that purpose, suggests that if the plan were adopted in all new churches, and in such of the old as are capable of it, of sinking a well near the great western door of the church, and fixing a forcing pump thereto, to the spout of which a short hose might be adopted, and which might also be so contrived as to fit the hose of the parish engine, and be under the care of the sexton, many very destructive fires might be prevented by the timely application of water thus easily supplied on the spot, as in most cases where a fire occurs it is small at first breaking out, and a few buckets well applied would be sufficient to extinguish it; while, as is well known, from the extreme difficulty which now occurs in procuring water at these generally isolated buildings, the fire has made an alarming progress before any supply of water can be made available. In some places, the rain water from the roof might be conducted into a tank, which would answer the purpose equally well, and also be made very useful when repairs are being made, and for the purposes of ablution, now so much neglected, from the absence of water in the churchyard.

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[*] To make the bars as equal as possible, we can indeed, after having bent and welded the ends, drill through all of them which make up a link of the chain, when cold; but it is evident in this case, that to prevent the drilling from diminishing the strength of the eye, we must either give greater size to the bar in this part or flatten it, involving a heating which injures the quality of the iron.

[†] There are, for instance, some red shear (hot short) irons which lose nothing by being wrought at a white heat, but which are injured in quality when wrought at a less elevated temperature. But the workmen cannot confine themselves to fulfil these conditions exactly, whence it happens, in irons which have even been proved, that the re-forged portions become bad, and consequently, that only the final proof can give evidence of this imperfection; but as we have just said, it is very difficult to prove curved bars.

[*] M. Lauraut recently attended to the work of the bridge of Roche Bernard, and has given me some details in regard to the *herse*, which can explain the objection of M. Frinot. The *herse* is made by laying the threads in a circle, and if they are perfectly parallel and evenly stretched, the inside ones are shorter than those outside; if ligatures are applied, and the *herse* is drawn out, as it must be to lift or pull loads, we see that the threads of the bundle, which from being circular are now straight, or even bent in opposite directions—the outside threads then must be thrust up together, while the inner ones, if they do not stretch, must break. Without the ligatures there would be a compensation between this lengthening and shortening, so that they actually injure the strength of the bundle; but it is the change of form, and not the ligature, which is the cause of the evil, and the *herse*, bound or not bound, would have the same strength, if it retained its primitive form, as is the case with cables of wire.

LEVELLING.

Sir—At page 434 of your journal, I have just read W. Bewley's remarks on the subject of attaining the correct bisection of a levelling staff; and although I cannot agree with his plan of "the holder moving it slowly and firmly to and fro, in the plane of the observer, the base of the staff acting in its seat as a hinge," because I believe, by such means that the base of the staff would in some degree work itself into the ground (except an universal joint was attached to the foot), which, if at a back station, would occasion a certain error; probably of much greater amount than would be occasioned by a reading from the staff when in an oblique position. The principle of adopting the *least* reading on the staff is of course correct, and is really well worth the attention of every person engaged in levelling operations. But I have always found, that with the most careful holder, and on a calm day, the inevitable unsteadiness of hand was sufficient to enable one to practise this plan with certainty. In windy weather, the vibration of the staff always ensures the same result, constantly passing and repassing the perpendicular. In conclusion, Sir, allow me to state, that in my opinion, the *simple* plan detailed in W. Bewley's letter is well worthy of your readers' attention; and there is the reproach conveyed in the postscript to W. Stevenson's letter, at page 26 of your last number, unmerited.

I remain, Sir,
Your obedient servant,
Peter Bruff.

Charlotte-street, Bloomsbury,
Jan. 13, 1842.

LONG AND SHORT STEAM VOYAGES.

Sir—A correspondent Z in your last number appears to lean to the opinion of Dr. Lardner respecting the profit to be derived from long and short voyages by steam. I think, however, he is not borne out by the examples adduced. With respect to the list of transatlantic killed and wounded, mentioned by him, it is necessary to say a few words in explanation.

"Sirius withdrawn."—The Sirius was a small vessel, and was never intended to be kept permanently on the transatlantic station. She was chartered for a voyage or two by the company owning the British Queen and President, while their ships were building, and though sailing from an Irish port, was, I believe, the most unprofitable of all, and the soonest withdrawn.

"The Royal William"—was also a small vessel, chartered by another company until their own vessels were ready.

"Great Liverpool transferred." The Liverpool was certainly unsuccessful. This arose partly from the circumstance of her return on the first voyage after being out some days, which created an unfavourable impression against her, and being an indifferent sea-boat, she never attracted many passengers. She has since been altered by giving her six feet more beam, and is now, I believe, a very superior vessel.

"United States or Oriental transferred."—She was intended for the station, but never made a voyage.

"British Queen sold." The British Queen made an average profit on nine voyages of £1256 per voyage; and before the opposition of the Cunard line, which is assisted by a Government contract, considerably more.

"The President lost."—The President made an average profit of £1350 per voyage while she ran. These two ships belonged to the same company, and would have paid a handsome dividend on their cost, had it not been for the Cunard* opposition, and the unfortunate loss of the President, which was insured for a fourth part of her value only. She therefore took to the bottom with her the £60,000 of the company's capital mentioned by Z, and swamped her owners.

"Great Western and Great Iron Steamer for sale."—I am unable to say whether these are for sale or no. The Company have some disputes whether they shall build their own ships or not; and as the courts have decided against them, their building-yard is advertised for sale. The Great Western has regularly divided nine per cent. on her cost, besides laying by a considerable reserve fund; so she can scarce be quoted as a proof of non-success with long voyages. Your correspondent says that a "recent meeting of the Peninsular and Oriental Company enables us to state, that oriental steam voyaging has been highly successful; and this result has been attained with the same vessels, and by the same management, that were incapable of realizing anything but loss on the New York line." That the vessels are under the same management, is entirely a mistake; that they pay a good dividend (seven per cent), is quite true. But how? The Company's capital is £300,000, and they receive from Government £66,000 for conveying the mails to Lisbon, Gibraltar, and Alexandria. It is evident that without this Government assistance, the Company's vessels, with their short voyages, would not be dividing £21,000 a year among the proprietors, but would, as Z says, be still realizing a most considerable loss. I think therefore, from what I have said respecting the Great Western and these latter vessels, it will appear, that the length of the voyage is of far less consequence than the probability of a full ship to make it with.

I have the honour to be, Sir,
Your obedient servant,
An Amateur.

MODEL MAPPING.

Sir—I have perused with considerable interest your report of Mr. Sopwith's paper on the construction and use of Geological Models, for which he was awarded a Telford medal by the Institution of Civil Engineers,—and I trust you will allow me to make a few remarks on the analogy his proposition bears to the one I have advanced in my little work of Model Mapping, in which I suggest, that in all cases where the owners of estates are desirous of informing themselves, of the material and undersoils, as well as the surface and contents of their lands, Model Maps should be extended in their usefulness, so far as to portray geological formation. The mode I propose is to sink shafts in the model correspondingly with the borings taken on the ground, and into these shafts to insert rods of the same length as the depth of the borings, coloured geologically, to vertical scale; each difference of colour agreeing precisely with the strata of subsoils, as reported by the borers. The rods would be made to fit neatly in the shafts, though easy of removal, and would assimilate in use to the Grocer's *Cheese-taster*, which, when withdrawn from the cheese, identifies its qualities. Of course, I would not be understood to feel otherwise than that Mr. S.'s method is superior for mining purposes, but as the one I suggest does not render a division of the model necessary, but conveys to the observer the pure information derived from the borings, I am induced to believe that landowners interested in geology, and not initiated in civil engineering, would prefer it, as the simplest and least troublesome method, were their attention turned to the matter.

I am, Sir,
Your obedient servant,
J. Bailey Denton.

9, *Gray's Inn, December* 14, 1841.

STUDY OF CIVIL ENGINEERING AND ARCHITECTURE.

Sir—Believing you are ever ready to give publicity to any suggestions which may have utility for their object, I beg to offer the following considerations, which, should you deem of sufficient importance to claim a place in your Journal, you will kindly insert. A very few years since there was no place in existence where the study of Civil Engineering or Architecture could be prosecuted as a separate science. The student designed for either of these professions was compelled to wander through an intricate maze, without guide or compass to direct him, and often, as is too well seen at the present time, entered upon his duties without having even laid the foundation of a scientific education. There have been some attempts of late to fill up this chasm in the educational establishments of this country, by instituting departments in several of the Colleges and Universities, where the attention of students is exclusively devoted to subjects in relation to these branches of study; as also by the foundation of the College for Civil Engineers. Now these have, I am aware, in part supplied this desideratum, but in part only. Who is it that derives any benefit from these existing Institutions? are they the few or the many? most undoubtedly those only who have money in plenty, and the greatest portion of their time to devote exclusively to the acquirement of knowledge. But there are still a considerable number who not having such advantages, enter prematurely into offices, and therefore engaged throughout the day, cannot avail themselves of these opportunities, and are consequently left without the means of preparing themselves for such important callings. To what can be attributed the fact that in nine cases out of ten, pupils pass through the term of their articleship without having advanced in any material point? merely, that they commence and continue almost wholly in ignorance of any principles, and unable to apply even those they do know. Now it appears to me possible to remedy this evil in a great measure by the establishment of some place where the evenings only would be set apart for the pursuit of the necessary qualifications, and unto which a library, museum, &c. might be attached, if practicable; thus affording to those so situated means of improvement which are at present not to be found. Could the attention of those in whose power it is to carry into effect so desirable an undertaking, be roused to a sense of its importance, that the subject might be fairly considered, there is little doubt but that the result would be beneficial.

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* The Cunard opposition is stated to have reduced the passage money 20 per cent, and to have reduced the number of passengers from an average of 240 to an average of 165 per voyage.

I am, Sir,
Your's, respectfully,
A STUDENT.

December 15, 1841.

ON COMPETITION.

SIR—Your correspondents have descanted frequently and largely upon the abuses of competition, and I concur generally in their censures upon existing practices. Without attempting however to discuss the merits and demerits of the subject, I will give you a case which may furnish matter for further comments; inasmuch as I believe it is in a great measure, if not entirely original, in respect to the course adopted.

The Magistrates of Devonshire advertised for designs for a County Lunatic Asylum, offering a premium of £100, or the chance of being employed to erect the building. About 20 designs were submitted; and after the committee had repeatedly conned them over, they candidly acknowledged their inability, without assistance and advice, to enter sufficiently into the consideration of all the numerous details, so as to be able to form a satisfactory judgment of their comparative merits. Accordingly they called in the aid of Mr. Hardwick, to examine and report upon the designs, in order to furnish them with clear and tangible data upon which their judgment might be grounded.

Mr. Hardwick having so long held the appointment of architect to Bethlehem Hospital, was therefore peculiarly fitted for the task; and it appears that he adopted the following course.

In reporting upon the whole collection of plans, after some cursory remarks upon the greater portion of them, which he deemed not worthy of a detailed consideration, he selected seven or eight of the most eligible, and made a tabular analysis of their contents under nearly thirty different heads; by enumerating of their various parts, by calculating the small quantities superficial and cubical, and arranging them in juxta position. Thus presenting at one view a comparison of the whole in all the various relations that can be expressed by figures; accompanied also by remarks upon their comparative merits in other respects.

The result was very curious and interesting; as for example, taking only the cubical contents and cost, the calculations of the competitors were found to range from 1½*d.* to 6*d.* per foot!

No conclusive judgment was pronounced in favour of any particular plan, the selection being left entirely with the committee.

Now it may be worth the consideration of your correspondents, whether the course described is not desirable in order to arrive at a fair and judicious decision—and if so, is it in the *power* of any committee, however zealous and honourable, to fulfil such a task; or even if they had the *ability*, could they devote the necessary *time* for comparing, analysing, calculating, &c? Further, if they could, and would do so, is it not better to be done by a professional man, who is not only more competent, but also *responsible* for the advice he renders? Is not such an ordeal of the designs calculated to detect fallacy and delusion, and thus prevent an injudicious selection? and is it not at the same time a great check upon collusion and jobbing? for under such an arrangement few committee men will be so daring as to vote in defiance of the merits of the case, with the liability of their corruption or ignorance being so readily exposed.

F. B. A.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.

[WE are indebted to our cotemporary the "Mining Journal" for an abstract of Mr. Vignoles' very valuable lectures, now in the course of delivery at the London University College. They will be found to abound with information of the utmost importance, not only to the student, but also to the profession generally.]

ON ARTIFICIAL FOUNDATIONS.

Lecture I. 25th Nov. 1841. After offering some comments on engineering generally, the lecturer alluded in particular to that important portion where the skill of the engineer was most required—viz., foundations. After some instructive remarks upon the subject, he said that for the foundation of bridges a network of timber had been used, and was found to be very good so long as it was under water; but if it were liable to become dry, and exposed to the effects of the atmosphere, it was sure to fail. He recommended concrete as far superior to timber; he had seen concrete forced into a quicksand, and no weight could afterwards force it out. Brick earth and clay form excellent foundations—the whole of St. Paul's, except the north-east corner, was built upon such a foundation, of from four to five feet thick; at the north-east corner, the architect being afraid to trust to the ground, it being rather softer than the other parts, had the clay removed, and a well of from twenty to thirty feet square sunk to a depth of about forty feet, where the hard bed was found; he then raised a solid mass of masonry to within nine or ten feet of the surface—arches were turned, and the foundation finished at an enormous expense; whereas, a few cubic yards of concrete would have answered equally well, if not better. All must have noticed the hole that was filled up in laying the concrete foundation of the Royal Exchange; there a few cubic yards of concrete did the work more expeditiously, and as well as the ingenuity of the mason could have effected it; he alluded to some of the most remarkable instances of the prodigality of architects in laying foundations, as the Barriére de l'Etoile (a triumphal arch at Paris), where the cost of the foundation far exceeded the amount of surface work; and the viaduct of the Valley Floré, in which a mass of solid masonry, thirty feet thick, was erected, extending all across the valley. In these cases concrete would have answered the purpose equally well, and at an enormous reduction in expense. Mr. Vignoles stated that the leading principles he wished to impress upon the minds of the students were—extension of base and equality of surface. He then, at some length, explained the different foundations that had been used for bridge building, and mentioned particularly Ranger's patent for curing defects where foundations have given way—viz., by using hot water to concrete applied in boxes, the hot water causing the concrete to expand. This was applied to the foundation of the Custom House when it had given way in consequence of a failure in the piling, which rendered necessary the application of an artificial for a natural foundation. He then remarked upon the various methods now in vogue for keeping the piles of bridges dry while under repair, alluding to caissons, and Mr. Tierney Clark's method of putting in the foundation of the landing place at Gravesend by portable coffer-dams. The Professor concluded his instructive lecture, stating his wish to popularise the knowledge of engineering as a means of benefitting the public at large.

LECTURE II. Wednesday, the 1st Dec., 1841.—In the first lecture Mr. Vignoles gave the general principles of the various descriptions of foundations; in the present he proceeded to illustrate those principles by diagrams. He stated, that if a good foundation were provided by nature, the subsequent operations were simple, the main point being to imitate nature as closely as possible. Where the soil was bad, considerable skill was required; for instance, in laying the foundation for the pier of a bridge, a wall, or a column, the first point was to give the base extensibility, in proportion as the natural soil was weak, so in equal proportion must the size of the base be increased—the pressure must also be equal; the soundness of the foundation not depending so much upon the amount of settlement as upon its equality. There were various ways of obtaining this—viz., by the use of concrete alone, or in conjunction with timber, timber alone, or stone, or brick. Having so much insisted upon the necessity of an uniformity, it must be supposed that no portion of the artificial soil should escape; where that was likely, *sheet piling* must be resorted to. He then, by means of diagrams, explained the nature of that method—it being by driving piles close together, all round the foundation; the piles being (say) four inches thick, and as long as might be necessary. This method entirely prevented the escape of the soil in any manner but in a vertical direction, and ensured an uniform sinking, however bad the natural soil might have been. He then alluded to a very large chim ney, twenty-two feet square, where the natural soil was a shifting quicksand; concrete was put in in layers, until the bed was eight feet thick; on this was placed a layer of flag-stones, five feet square; eight days after the work was completed, the whole sunk eighteen inches, without the least deviation from the perpendicular. Other modes had been adopted, amongst which was the following:—A number of timber balks were laid across, and concrete placed in the spaces between; then filled up with bricks; timbers were laid in a cross direction, and the flat stones placed upon them. In this instance the wood was laid where no change of atmosphere could affect it. The nature and use of a coffer-dam was then explained, and the Professor, at some length, showed the danger of incautiously drawing the piles; the vacuity occasioned by their withdrawal being filled up by the surrounding matter, greatly injured the stability of the foundation. In making one of the London bridges, a great disfigurement had occurred in consequence of the incautious withdrawal of the piles, one side of the pier having sunk one foot. The modern plan to prevent such accidents was to have a double coffer-dam—the piles of the inner one being cut off, and the outer piles might be withdrawn without danger. In laying foundations, he supposed there was a layer of soft ground, of moderate depth, with a hard substrata; piles must be driven through the soft soil into the hard bed; a very slight depth would be sufficient, but still, in most cases, sheet piling would be necessary.

The Professor said that he was lately indebted to an officer of the Bengal Engineers for an account of a very ingenious method, almost universally practised in laying the foundations of bridges and temples in India. It would not answer here, labour being so dear; but there, where wood was very scarce, building materials in great plenty, and labour very cheap, it was the simplest and most effective that could be imagined. From the explanation, it appeared that the system was the same as piling, but, instead of using wood, small wells of brickwork were substituted. Take, for instance, the pier of a bridge; a small well of brickwork was constructed—say, six feet deep, seven feet in diameter, with a hole through it, three and a half feet in diameter; this is placed on the sandy bed where the foundation is to be made; a workman gets into it, and undermines the well from the inside, the earth being drawn up in buckets, additional layers are added to the top of the well until a sound bottom was reached; and the singularity was, that there was not one or two of these little wells, but hundreds, and, in certain cases, to a depth of fifty-five feet; arches were then thrown across, and the superstructure raised. When the foundation was in the bed of a river, the excavation went on by the workmen diving through the water to the bottom of the well, and working there until obliged to come to the surface for air; for instance, through ten feet of water in the river and to the extent of forty feet of water in the well—one of the most extraordinary instances of perseverance upon record. English engineers had somewhat abridged the labour by substituting an oblong square of fifteen feet by four feet, with two elliptical holes for the workmen, so that, instead of three wells of six feet, they get one of fifteen feet—the principle being precisely the same.

In France a number of bridges had been built where the water was not rapid, upon a very simple foundation; a framework of timber being made, furnished with short piles at the corner, and laid in the bed of the river, and the superstructure raised upon it by means of a wooden diving-bell. The *pier perdue* was another way, but could only be used in still water; a quantity of stones were thrown in until a foundation was obtained; where there was any current this foundation was sure to give way, as in Plymouth Breakwater and Kingston Harbour. He then alluded to the case of one of the London docks, where the wall, being made with too great a curve, from the want of pile sheeting, the soil gave way—the engineer adding fresh matter until the toe of the wall actually appeared (to the astonishment of all) above the surface on the other side. He then gave examples of several original methods of preparing for the formation of foundations in Italy and Ireland by means of baskets of stones, &c.

CONCRETE.

The Professor next explained the nature of concrete, and gave directions for its formation—viz., one part of lime, twice that quantity of sand, and twice as much broken stone, or gravel, as there was sand.

The goodness of the concrete depended upon the quality of the lime. In making concrete, it must be borne in mind that the materials were far more bulky separate than when mixed; for instance, to make a cubic yard of concrete, which contained twenty-seven cubic feet, it would be necessary to have thirty-four cubic feet of materials, besides the water. The three ingredients should be mixed dry, and the water added; in slaking, the concrete will expand about one-thirtieth in bulk.

The great expense of coffer-dams, and of piers generally, had lately led to a very peculiar construction of bridges by piling only, as, for instance, in iron bridges, no masonry being used. The Professor stated, that he had built seven or eight bridges upon that system; the piles were driven in and the iron work erected upon the wood. It had been tried to substitute cast-iron for piles instead of wood, but they had not succeeded, the iron being very liable to break. He also alluded to a beautiful arrangement for fixing branches to piles by means of a sliding collar, but which it is impossible to explain without diagrams. A French work, above 200 years old, was produced, with some very curious engravings of the modes then in use for securing foundations, and which proved that we are using the same means at present, and that many of our so-called new processes were in use at that time. He then concluded by stating, that, at his next lecture, he should bring forward some more general rules respecting foundations, and after that proceed to consider the best method of securing slopes of earth, now so generally in use.

Lecture 3. Wednesday, 8th Dec., 1841.—Mr. Vignoles explained that at his former lectures he had applied the term "concrete" too generally, and would now explain the difference between "*beton*" and "concrete." Beton was formed of the usual quantity of sand and gravel, broken stones, &c., but, instead of using the ordinary stone lime, hydraulic lime was applied. He then stated that beton is used exclusively under water, concrete only where water does not get in; beton never sets until it is under water, while concrete will not set except it is dry. The lime used for beton must be first slaked, while for concrete it slakes in the process of mixing. Beton sets best when let down gently in cases, and concrete when scattered from an eminence. Beton takes months to become hard, while concrete hardens in a few minutes. The both are in purport essentially the same—to form an artificial stone or rock—the one for works under water, and the other for those on land. He then alluded to the knowledge of the ancients of beton and concrete, and read extracts from the works of sundry authors, from Josephus to the present time, proving that assertion. The use of piles was also very ancient, the foundation of a brick pyramid in Egypt having been constructed on that principle. After impressing upon the minds of the students the great importance of a good foundation, and the efficacy of concrete for attaining that end, he concluded, by stating that his next lecture would be again on the subject of foundations, and after that he would proceed to lecture upon slopes of earth, and explain the causes of the late accidents upon the different railways, pointing out where the errors of judgment had occurred.

Lecture 4. Wednesday, 15th Dec. 1841.—Mr. Vignoles commenced by explaining the mode in which piles were driven in, and produced a model of a pile-driving machine (from the museum of the college), by means of which he showed the method in which steam power was applied to that machine for expediting the work—stating, however, that, far from that application being a novelty, he had used it himself twelve or fourteen years ago.

ROCK FOUNDATIONS.

Having treated in his former lectures upon foundations in natural soils, or various kinds of artificial bases, he would now notice such as were of the composite order, being partly on rock, and partly requiring artificial means to render them sufficiently sound for the required purpose. It often happens that, in making a bridge, there may be rock on both sides of the river, and the first pier may rest upon rock, while the second and third may have an insecure foundation, in consequence of a "pot-hole" (as it is called) of sand unexpectedly being discovered in the very spot where these piers are to be erected; the only plan to get over this difficulty is to cut the edge of the hole in steps; sheet-pile it a short space from the wall of the hole, and fill up the intervening space between the piling and the hole with beton, or some other substance, and thus form a continuation of the rock itself. Difficulties also present themselves in solid rock foundations; for instance, in such an erection as that at the Devil's Bridge; the ravine over which the bridge is to be thrown may have been formed by the running of water—the strata, accordingly, runs with the usual inclination on both sides. If foundations for the piers of the bridge were not sunk deep enough into the rock, the press of the water filtering through the fissures of the strata have such force that, notwithstanding the resistance of the arch, he had known instances of the pier being actually pushed outwards. The only method of avoiding this was to sink the pier so low into the rocks, and, by means of steps, secure it so firmly, that the force of the water must *break* the pier—not force it outwards—before it could destroy the bridge. The Professor, before going into the question of rock foundations, begged to state, that, in these lectures, he only laid down the general principles of foundations; he could not go into the details of the business, and the circumstances of stone foundations were so varied, that it was only by a life of labour and experience that the best method could be arrived at; he wished that each student should, in his private study, well consider, and, by reading, test the correctness of the principles which he laid down for their guidance. A whole year's lecture, repeated every day, would be no more than sufficient to draw the attention of the student to important points—the details could only be gained by practical experience. In preparing the foundation of lighthouses, the whole resources of the engineer must be called into action. A lighthouse must be built in such a manner that it must actually grow from the rock; there are instances where lighthouses have fallen in a body. He could mention one in Ireland, the foundation of which was a solid rock; he saw a party who witnessed its fall, and who informed him that it fell in a solid mass, tearing away a portion of the rock with it. The fault was, that the foundation was not sunk deep enough into the rock. He then alluded to the celebrated Pharos (or Pharos) of Alexander, which was justly reckoned one of the seven wonders of the world; it was built about 283 years B.C., and received its name from the island on which it was built; it was 550 feet high, and the base was 150 feet square, and could be seen at a distance of 40 English miles. Josephus, and many other authors, had given descriptions of it, which pretty well agreed; and what was most extraordinary, that the very same method of making the foundation was practised then as now. The stones were dovetailed together, dowelled, and run with lead, so as to firmly secure them in their places. The cost of the building amounted to no less a sum than 200,000*l*. of our money, and it lasted above 16 centuries; no diminution in its height occurred until after a 1000 years from its erection, at which time about one-third of its height was wasted away by time, and it was only within about 400 years that the whole is supposed to have been destroyed, and that only by means of an earthquake. He then remarked, that it was very seldom that the name of an engineer was handed down for 2000 years, but all accounts agreed that Sosastros was the name of the engineer who erected this wonder of the world. The celebrated Corduan, or, as it is generally called, Cordovan Lighthouse, at the mouth of the Garron, is built upon the same principles as the Pharos; this lighthouse is, however, circular, but the masonry is not calculated for durability, it being built of freestone. The expense of this lighthouse was enormous, as must be supposed, when millions of francs were expended upon ornament, which was the more absurd, when it was considered that it stood upon a barren rock, in the middle of the sea. He could not help quoting a line of Pope—

> 'Tis only usefulness that sanctifies expense.

This is a sentiment that he wished to impress upon the minds of all his students, for it was a great fault of modern engineers to expend great sums upon ornament, which could be far better employed upon actual necessaries. He then turned to the Eddystone Lighthouse, and related the histories and fates of the two lighthouses preceding the one now standing, which was erected by the genius of Smeaton, and strongly recommended his pupils to read the account published of that great work. The Eddystone rock is peculiarly interesting to the engineer; it is found first at about one mile deep in the ocean, and then rises gradually about one foot in ten, until it reaches near the level of the sea, when a sudden crop makes its appearance, and rises above surface. From the peculiar formation of this rock, there is always a heavy run upon it, which renders it so very dangerous. The learned Professor, after explaining at some length the process of the erection of this celebrated lighthouse, concluded his lecture.

ON EARTH WORK.

Lecture 5. Wednesday, 22nd December, 1841.—The Professor commenced by stating that earthwork, taken in the present extended sense of the word, was but little known to the ancients. The gigantic operations in earthwork of modern times correspond with the viaducts of the ancients. Our earthwork may be confined to excavation, cutting, and embankment, or getting and filling, as ordinarily denominated by contractors. He then went through the whole process, giving the scientific and common names of each description of work. With respect to the works of the ancients, in the canal made by Cyrus, the Phœnicians were the only workmen who cut the canal with slopes—all the rest employed cut straight down, and, in consequence, the former stood, while the latter fell in. The River Po, in Italy, was a curious instance of embankment; this river is situated in a very flat country, and makes an annual deposit of a calcareous matter, which, hardening, raises the bed of the river in a slight degree every year. The ancient inhabitants, to prevent their country from being inundated, were obliged to raise a small embankment on each side of the river—perhaps two or three feet high—which, having served for some years the desired purpose, and the bed of the river having become higher from the deposit, the embankments required to have still more added to them, until, after the lapse of centuries, the bed of the river, from the constant deposit of calcareous matter, and the consequent necessary additions to the embankments, to the height of thirty feet, is now several feet above the level of the surrounding country. This work looks like one of our modern gigantic works, but it bears no comparison to the labours of the present day, it being but a work performed from year to year, in small portions at a time, while ours have been formed at one operation. From all his researches, he, therefore, came to this conclusion, that, until late years, earthwork was but little known; he could make the same remark with respect to cutting. This work was first treated systematically by military engineers in fortifications on the continent after the invention of cannon; authors of that period lay down many curious rules for forming ramparts. Various useful calculations are given to determine the best mode of making the matter taken from the ditch exactly sufficient to form the rampart, in order that there should be none either to procure or carry away. The next is in the construction of canals; the same rules were followed as in the construction of ramparts. In road-making the same calculations were made; the whole aim of the engineer being to make the imaginary line, called the "balancing line," so perfect, that the earth removed from the eminences should fill up the hollows in the irregularities of the country through which the road was to be made. The cause of these fine calculations was the difficulty and expense of carrying away the superfluous earth to another place. The absence of great undertakings on the continent is attributable to the want of our modern appliances to get rid of the superabundant matter. In the contracts sent in by foreigners for works abroad, it is amusing to see the finical exactness with which the contractors calculate the expense of removing the first 100 yards, then the next 25 yards, and so on increasing until they get to 300 yards, beyond which the price is enormous. It is only within the last three years that they seemed to have the slightest idea of the plans in use in England for facilitating this work; it is certainly not more than 30 years ago that we commenced using the tramroad. First of all the only plan was to remove the earth in barrows, then the clumsy three-wheel cart was introduced, after that tramroads, and now edge-rails, with the application of a locomotive, so that 30 years has changed the load from 2½ cubic yards to nearly 100.

Before railroads came into general use, deep cuttings were executed, and one remarkable instance Telford has left behind him in the Birmingham Canal, which is remarkable for boldness of idea and success of execution. Near Market Drayton there is an embankment, begun 15 or 16 years ago, and which is as yet hardly finished, so great has been the slipping and so difficult the remedy. This work is a remarkable instance of combined bad effects of a bad mixture; the slopes have flatted down until nearly in the proportion of 14 to 1, and it is now more like a large hill than an embankment. There is an instance of a deep cutting, by Dodd, at the Highgate Archway; it was intended, first of all, to make a tunnel, but, from the constant slipping of the earth, it was obliged to be made into an open cutting. The present bold mode of cutting down large hills and filling up deep valleys, in the formation of railways, is due to George Stephenson, and in the construction of large cuttings and embankments for canals to Telford, whilst Dodd made the largest cuttings for roads. On the Holyhead-road the failure of the embankments and cuttings in the London clay will teach a good lesson to the young students. The point to be considered is, which, of masonry, aqueducts, tunnelling, embankments, or cuttings, would be the cheapest mode of doing the work proposed. At the present time earthwork is the cheapest, for modern practice has reduced it to a price per cubic yard. In the contracts for the Paris and Rouen Railway, the contracts sent in by the French engineers were invariably 3 or 4 times the amount of those sent in by English contractors—thus, notwithstanding the expense of transporting the workmen into France, the whole of that work is in the hands of Englishmen.

The engineer, to form a just calculation, must well study the character and mechanical properties of the soil and the necessary slopes. Experience alone can teach these points. There are many varieties of the London clay, which, when cut down to a certain depth, on exposure to the atmosphere are sure to slip; another cause is, the great haste with which the embankments, &c., are formed. When the water does not penetrate, this clay is very hard, but after exposure it melts away, like tallow, and the only remedy is to get rid of the water by draining. When a slip takes place, the toe of the embankment bulges forward; in the first instance, the surface should be well drained a short distance from the edge—the drain to be puddled, in order that the water should not penetrate; borings should be made horizontally and the water tapped; when expense and time are no objects, the whole should be cut in steps, and drained by means of wattles, so that, if a slip takes place, it is only partial. The force with which the toe of the embankment bulges out is such that a wall of masonry would be of no use, as it would be pushed out; the most effectual preventive, or remedy, is wattling and bush drains. When time will allow, it is better to make the embankments in layers, and between each layer of earth putting in a course of brushwood, clippings of hedges, or wattlings. When embankments are obliged to be poured out hastily, allow them to take their natural slope, and if it slips let it remain, for however much it may be attempted to reduce it to its former shape, it will still again slip and regain its position. A good practice to provide against slips is to form a slight abutment of earth, a short distance from the toe of the slope, so that it should stay the slip if it takes place; this plan is more particularly available when the work is obliged to be erected on a natural slope—for instance, on the side of a hill. The Professor, then, for the information of the younger students, explained, by diagrams, the nature of slopes, and the meaning of the expression "two feet to one," &c., and concluded by recommending that, in forming slopes, the engineer should run some risk of slips, in order to save the great expense of removing more earth than is actually necessary—the cost of repairing these slips being but little in comparison. He likened the work to an insurance on life—the risk to be run being calculated upon by precedents. The principle is to get the greatest extent of work finished at the least possible expense, and many of the great slips that have taken place might have been prevented, or speedily cured, had the plans he laid down been better followed.

Lecture 6. Wednesday, the 29th Dec. 1841.—Professor Vignoles stated that, before continuing the subject of earthworks, he wished to set right an erroneous impression with the public, in consequence of an expression he made use of at his last lecture; he had then recommended that "the engineer should run some risk of slips, in order to save the great expense of removing more earth than was actually necessary—the cost of repairing those slips being but trifling in comparison." He need not say that he so expressed himself, but it was always on the supposition that no risk was to be run where there was the remotest probability of danger. He mentioned this because of the circumstance of the slip on the Great Western Railway, which was attended with such fatal results, and happening only a few hours after he had made that statement. From all that had been stated, it appeared that the slip itself was but very inconsiderable; the cutting where it took place was 57 feet deep, the slope two to one, and the width of the road 40 feet; the slip took place about half way up the bank. A number of smaller slips had occurred, and tiles were used for draining instead of bushes, &c., to cure them—still the mode of curing them was the same as he advocated—by drainage. As he had before stated, the slip itself was very inconsiderable, but, by having nothing to check it, the earth fell upon the rails. A doubt seemed to exist whether the concussion produced in the air by the passing of the former train had not brought it down, for the accident happened in the interval between the passing of the two trains—the first one having proceeded uninjured, whilst the latter was attended with such fatal consequences. If the precaution had been taken, when it was first observed that a slip was likely to occur, to put up a fence of hurdles to check its advance to the rails, doubtless the accident would not have happened. The manner of the slip showed that it was caused solely by the infiltration of water, probably a considerable way back from the edge of the cutting, or, perhaps the water had found its way in by the ditch along the top; the water which had thus got into the soil having expanded during the frost, the sudden change of the weather brought down the earth. The Professor then, by means of a diagram, explained the nature of the cutting, from which it appeared that the "top lift" was deposited in spoil bank; at the top of the cutting a drain had also been cut, but he was of opinion that such drains were injurious, when the soil was at all precarious. The spoil bank was not the occasion of the slip, since it did not take place at the top, but bulged out in the middle. Although this slip was very small, from the fatal effects which attended it, it was the more necessary to guard against the recurrence of the like; there were but a few feet of earth on the rails, yet the effect was the same as if so many planks had been placed upon them. The Croydon slip arose from the same cause, but, though so much larger, no accident occurred. In the late accident there were but thirty or forty waggon loads of earth, and all was right again in a few hours, while in the Croydon slip 3,000 or 4,000 cubic yards of earth fell; the soil in both instances consisted of the London clay, with pot-holes of sand. It was clear that the accident was not to be set down as one of cutting, similar slips having taken place upon cuttings not more than twelve or fourteen feet deep. He must impress upon the minds of the students that it was not the length or depth of the cutting which regulated the slopes, but the soil and practicability of drainage; unfortunately it was impossible to know exactly how these matters might stand, experience alone could teach them. He had dwelt long upon this subject, but he wished it to be understood that it was well-judged economy he advocated, not such as would, in the least degree, tend to produce such fatal effects as in the case previously alluded to.

The balancing of the line was equally necessary for railroads as for canals or common roads; it should be the engineer's aim that the quantity of earth from the cuttings should be as near as possible sufficient for the embankments; compared with former times, the mode of transit was so much facilitated, that where some years back it was necessary that the balance line should be limited to the hill to be cut through, and the valley to be filled up, now the line might extend two or three miles. It was essential in balancing that the engineer should be aware of the different degrees of compressibility of the matter; it was known of sand that it would occupy the same cubic contents in the embankment as it did in the hill, and one yard or 100 yards of gravel would be still the same, but in clays it was very different, they occupying less space in the embankment than they did in the hill, in their original position; 100 yards of clay would not make 100 yards of embankment, the average amount of compressibility being not less than 10 per cent., or even, upon occasions, as much as 15 per cent. He had known occasions when 100 yards cut from a hill had only made 85 yards of embankment, but, upon an average, it would require 110 yards of clay to make 100 yards of embankment. Rock cuttings, on the contrary, expanded, because the solid rock could never again be restored to the same degree of density; the difference would vary much, according to the size of the fragments, but where the pieces were large, 100 yards would make 120 yards of embankments.[*] Chalk, again, would be rather upon the excess, though much depended upon its quality. In rock cuttings you might make them nearly perpendicular, but in chalk much discussion[†] has arisen as to what was the proper slope, some engineers having even recommended that it should overhang the road, but he contended that it should slope, to carry off the water; he had found a slope of one quarter to one generally sufficient. Rock chalk would stand perpendicular, while several of the softer descriptions would require a slope of one-half to one, or even two to one.

The Professor then proceeded to speak of the correct mode of computing the quantity of earth in a cutting or embankment, and made a section of a hill half a mile long, to be cut down, the true cubic contents of a portion of which was 332,000 cubic yards, computed according to the prismoidal formula; but the ordinary method by which contractors would calculate the contents of the hill, by mean heights, would only show 310,000 cubic yards—that is to say, there would be a difference of 22,000 cubic yards against the contractor, the consequence of which had been, that the person contracting to cut down such a hill, at so much per yard, would lose, from his bad method of calculation, above £1,000. Another method was also in use—calculating by the mean area; which system, instead of 332,000 cubic yards, would show 376,000 cubic yards, being an excess in favour of the contractor of 44,000 cubic yards. Many contractors had realised large fortunes by mean areas, and sustained serious losses by mean heights. Having thus shewn the erroneous methods of calculation in use, he then, at some length, explained the prismoidal formula, accompanying his instructions with many diagrams, without which any attempt at explanation on our part would be useless. The learned Professor concluded his lecture by strongly recommending a close study of mathematics to the junior (all) students, as the greatest assistant to the labours of the civil engineer.

Embellishments of London.—We have heard it stated, and we believe on good grounds, that a great and striking improvement is about to be made in the appearance of Piccadilly, consequent upon the removal of the ranger's house in the Green Park, which will be demolished early in the spring. This tasteful suggestion, we have heard, was made by the Premier, and is to consist of a noble terrace and public walk, from the gate into the Palace-gardens at Hyde Park corner, to the junction of the houses at the lower end of the basin. The form of the ground on this line is particularly favourable to picturesque effect in laying out and planting, and to architectural beauty of design in the esplanade. Fountains and statues, too, are likely to be introduced, to add to the grandeur of the plan. give encouragement to the arts, and combine the whole with the palatial residence of the Sovereign, by carrying it, perhaps, further on hereafter, along the line opposite to Grosvenor-place. The magnificent equestrian statue of Wellington, now casting by Wyatt, will surmount the arch facing Apsley house; and wes ee no reason why it should not be balanced at the other termination by a statue of Sir Robert Peel, together with his name to the work, the idea of which, as we have mentioned, is understood to have emanated from him. At all events it will be a splendid embellishment of this principal street in entering the caiptal from the west.—*Literary Gazette.*

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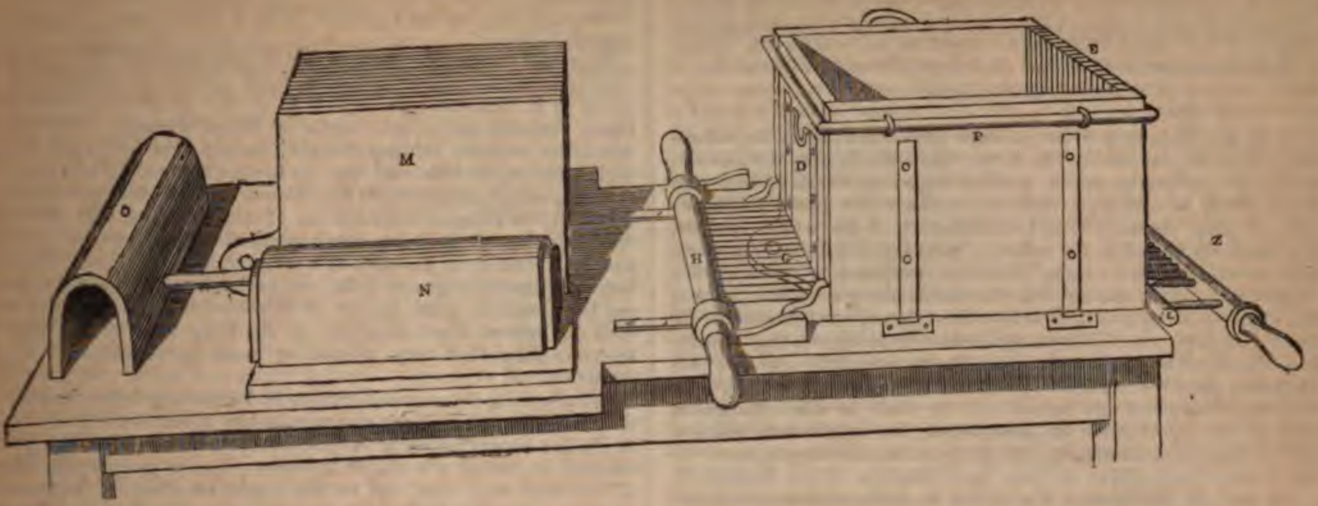
[*] These remarks strongly corroborate those of an American engineer, inserted in the Journal of December last.—Ed. C. E. & A. Journal.

[†] See the evidence on the Brighton Railway before the House of Lords.

IRVING'S TILE MACHINE.



In the last number of the *Journal*, page 8, we gave a plan and description of this machine, which was not properly understood from the want of the annexed perspective view of the apparatus, which we have since had drawn.

THE INDUSTRIAL STATE OF BELGIUM.*

The Belgians, besides a soil made fertile by their own exertions, possess in their mines of coal and iron the elements of a great manufacturing power; and we have already found them, by their productions of cotton and woollen cloths and hardware, formidable rivals in many foreign markets. Once the tame occupants of the battle-field of Europe, they have now in this age of peace availed themselves of their frontier position, to harass the trade of the surrounding countries; often, it must be acknowledged, by expedients not the most justifiable. The only characteristics which the Belgian tribes possess in common, the only features of a national organization, are of a very unpromising nature; but it takes time to make a nation, and give it the high-souled character of a great community. We do not complain of the Belgians for employing English workmen to beat us out of the market, for that is rather a good accessory of a disposition to enterprise; but we fear that the spirit of piracy, which breaks out in their literary undertakings, is too deeply-rooted, and that its demoralizing influence will long affect them. We find the Belgian journals ever holding forth to public attention some promised wonder of native growth; but we do not find, on after-inquiry, that these visions and speculations are ever brought to any tangible form. The spirit of imitation is a good one; but that of piracy is so demoralizing in its influence on the mind, that we cannot augur well of future success to Belgian enterprise. It will take many years before the Gascons of the north can be sobered down to the business-like pursuits of a steady people; and until that takes place, England has little to fear from their rivalry. These are remarks which are not unnaturally suggested to us, when we read the prŏem of a new Belgian periodical, devoted to the industrial arts. "Belgium," says the author, "occupies, without fear of contradiction, a first-rate position among manufacturing nations, as the brilliant exhibition of its productions demonstrates to every eye." This is an introduction so truly Belgian, that we shall be prepared for any future escapade of our new contemporary.

Until the present time, it appears that, with two exceptions of works produced by the editor of the one now founded, no periodical devoted to the mechanical sciences has yet been attempted in Belgium. We are rather surprised at this, but we hope that the effort now made may be successful. Belgium, it is known, has at Brussels a very fine museum of the industrial arts, which is thrown open to the public, and is a favourite Sunday walk of the working classes. The Director of this museum is M. Jobard, a gentleman to whom Belgium is much indebted for his exertions. The state of school instruction is very good; but the point in which the Belgians are mainly deficient is in a workmanlike character, which is not to be created in a moment. The number of patents issued in Belgium is pretty large, but they form no criterion, either of the progress of the arts, or of the ingenuity of the Belgian people. We find that the numbers are:—

1830	5	1836	76
1831	15	1837	134
1832	30	1838	280
1833	42	1839	269
1834	48	1840	326
1835	62		

The small number in early years is to be accounted for by the effect of the revolution, and the embarrassments of the country.

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* Bulletin du Musée de l'Industrie. Brussels.

THE "SLIDING SCALE."

Sir—Being fond of the combination of utility and simplicity, I send you an idea of a "*Sliding Scale*," not for debate in the House of Commons, I assure you; but to be submitted, through *your* journal, to the judgment of the honourable professions of the civil engineer and Architect, for their universal adoption. The sliding scale I propose is to be drawn on a separate strip of paper, and substituted in lieu of or in addition to the present one usually put on plans, maps, sections, &c. It may be in length proportioned to the size of the plan, and about half an inch in width, of the same paper, and kept always with it, by being slid through two or three cuts made with a penknife at right angles to the roll of the paper. There it lies, and is available at a moment's notice, for examining the plans as to details, additions, alterations, and so forth. About five minutes extra care in drawing this scale makes it an invaluable attachment to any plan. The experience of almost all persons conversant with these matters must suggest cases of occasional great inconvenience arising from not having a pair of compasses, plotting-scale, or even rule, aye, or pencil at hand, at the moment when most wanted, say in a field, on a scaffold, when exhibiting designs to directors, noblemen, gentlemen, &c., by your having put on hastily your No. 1 coat, to be punctual to appointment, leaving all your conveniencies in the pocket of your working one, snug in your study. In some instances very unusual sizes for plans may have to be adopted; and here, too, the sliding scale becomes useful Trusting to the valuable assistance of your vote, in my endeavour to pass the above suggestion, on its announcement in your February number,

Believe me, Sir,
Your obedient servant,
W. Bewley.

Dublin, Jan. 19, 1842.

P.S. By way of addendum, in reference to the *last* letter on his vernier reading-staff (staves, I doubt,) of Mr. T. Stevenson, and his few parting words,—I am sorry, for his sake, my estimate of his *improving* qualifications was so just.

REPORT ON THE GAS FURNACES USED IN THE IRON WORKS OF WASSERALFINGEN, BY M. H. SCHOENBERG.

(Translated for the C. E. and A. Journal, from the Bulletin du Musée de l'Industrie.)

One of the most important modern improvements in the manufacture of iron we owe to M. Fabre Dufanre, Mining Counsellor, Director of the iron works at Wasseralfingen in Wurtemburg, who has succeeded in collecting from the chimney the gases which are formed in blast furnaces, which constitute the flame which escapes, and to use them as fuel in the refining, puddling, and balling furnaces.

The use of the furnace flame for several purposes, as warming the air used for the blast, roasting lime and ore, making coke, and heating steam engine boilers, has been known these seven or eight years. It has not, however, been hitherto practicable to produce a higher temperature than red heat, which was a limit to its application; while by M. F. Dufaure's process any degree of heat required may be obtained. The principal distinction of this method is in the mode by which the gas is burned, by the introduction of atmospheric air supplied by bellows, and in the ingenious construction of the furnaces and fire-places.

At Wasseralfingen there are now three furnaces in use worked by gas, but the refining furnace is supplied from the southern blast furnace alone, which is done by simply introducing a tube to a certain depth in the fire-place of the blast furnace. It appears that about a sixth or a fifth of the gas evolved is collected by this method; and, notwithstanding this subtraction, no diminution is observed in the power of the flame which escapes. In the refining furnace there are thus produced 175 metrical quintals of fine metal, partly with a radiated crystallization, and partly with a ball-like structure, but all of a silver white. The gas refining is so complete, that the iron is produced highly decarburetted, and freed from all impurities; among others, from phosphorus and sulphur. The waste, which in common English refining is never less than from 9 to 10 per cent., is not more here, when the furnace is in good order, than 1 to 2 per cent.; and by this process a greater quantity of fine metal is obtained than if pig iron had been used. It is to be further observed, that the pig iron passed through the furnace here consists only of castings, which, as is well known, have often a good deal of sand mixed with them.

The operation is so well arranged, and proceeds with such uniformity, that it rarely meets with those casualties common in the usual process of refining, while the cost of manual labour is also less.

The results of puddling by gas are not less satisfactory. The puddling furnace at Wasseralfingen is supplied with gas from the northern blast furnace, into the fire-place of which are plunged two suction pipes, by which enough gas is collected, to work a puddling furnace and a refining furnace; but the power of the water-wheel which works the blast apparatus not being great enough, these works can only be supplied alternately. The temperature of the puddling furnace is, from the nature of the process, higher than that of one fed with wood, coal, or turf; the flame also is clearer, and transparent, so that the workmen can easily watch the operation, and carry it on regularly. In each of these operations the furnace is charged with 1¾ or 2 metrical quintals of fine metal, previously heated to a red heat by another furnace; and at the end of an hour and three-quarters, or two hours, the effect is produced. The waste of fine metal in this process is very small, the mean being only from 1 to 2 per cent. The quality of the iron is excellent. A feature peculiar to gas-puddling is that the formation of slag and its reduction goes on simultaneously, so it is never thrown away. The produce of the puddling furnace is 125 metrical quintals per week.

The operation of refining in the gas furnace has, like the preceding, considerable advantages; but the results have not yet been so important as in the preceding cases, and the quantity of waste is still considerable. The draught of the furnace is good, and the temperature sufficiently raised; so that, unless an accident occur, the produce is 150 metrical quintals per week.

From what has been already said, it will be seen that the results of the gas furnaces at Wasseralfingen are most satisfactory. Even with castings and rubbish, bar iron of excellent quality is produced, with a waste of not more than from 12 to 15 per cent., and without any consumption of costly fuel, or rather, by making use of a combustible matter, which hitherto has not been turned to account.

Belgium is the only country in which M. Fabre Dufaure's process has not been introduced, while in other places it has been extensively used. In England, at Messrs. Hill's works, at Merthyr Tydvil; in Germany, at the iron works of the King of Bavaria, Grand Duke of Baden, Princes of Furstenburg and Sigmaringen, Duke of Anhalt, the Saxon Iron Company, Count Einsiedel in Prussia, &c.; in France, at Lucelle; in Hungary, at the works of Count Andreasky and M. Inglo; in Russia, at those of the Prince de Bukna and Count Malzon; in Sweden, at Mr. Ekmann's; and in Italy, at the works of Dorgo, on the Lago di Como.

At one of the last meetings of the French Institute, M. Dumas read a letter from M. Grouvelle, giving some further particulars not contained in M. Schoenberg's report, as to the process used by M. de Fabre Dufaure in the iron works of Wasseralfingen. The practice is to carry into the refining furnace the pig iron delivered from the high furnaces, and not cold iron, as is usually done. The object is to save the caloric employed in the fusion. The puddling furnace produces 10,000 kilos, or about 9½ tons of iron per week. At this time a third blast furnace is being constructed, and steam engines are being put up, to work the gas plan on a large scale. M. Fabre Dufaure's first experiments began in 1837, and took place on refining cast iron; and the processes used by him at Wasseralfingen were kept secret until the present time, by desire of the King of Wurtemburg, who was unwilling that they should be known immediately in other countries.

After making this communication, M. Dumas reminded the academy that he had received about two months ago specimens of iron obtained in France by gas puddling in blast furnaces, by means of the process adopted at the iron works of Treveray, by the proprietors, Messrs. D'Andelarre and Lisa, and by the engineers, Messrs. Thomas and Laurens. He added, that the puddling furnace set up at Treveray has worked very well, and has already sent produce into market. In this furnace is refined iron, which is produced in the same way as by the common puddling furnace used in Champagne. The gas of a single blast furnace producing 5 cwt. of iron per day is enough to feed it; a result which proves that all the cast iron produced may be converted into bar without farther fuel, while such a result cannot be deduced from the work at Wasseralfingen, where the quantity of iron produced even at present is much smaller than the quantity of cast iron afforded by the two blast furnaces at those works. M. Dumas states the advantage of the Treveray gas plan to be an improvement in the quality of the iron, which has all the properties of charcoal iron, a considerable diminution of waste, and a great saving of fuel. It is to be further observed, that no effect is produced on the blast of the furnaces from the shafts in which the gas is collected. M. Dumas remarked to the academy a passage in M. D'Andelarre's letter, that the idea of using combustible gases for the same purposes as other fuel had been long since suggested by M. Thenard, in his public lectures; and the importance of these processes, which promise much, lies principally in the apparatus, which has enabled them to be successfully used.

THE ROYAL EXCHANGE.

We had hoped that the silly, nonsensical fuss of "first-stone-laying" was nearly gone out of fashion. The ceremony of the kind which has just taken place at Cornhill must have been a somewhat expensive one; and so far perhaps may augur well, as an indication that no cost will be grudged in decorating and finishing up the new Royal Exchange, not forgetting sculpture to the pediment of the portico. Still, the money which has been so idly squandered away, might have been laid out with some little degree of reason, had it been applied to the erection of a temporary model, formed of timber and canvass, of the portico itself, executed on the intended scale, as has been sometimes done in France. A full-sized model of that façade of the Exchange—which might have been allowed to remain until that part of the structure shall be actually commenced—would have enabled us to judge what effect the portico will have upon the Bank, and other buildings in its immediate vicinity. It would have been better still, had the money expended upon a mere brief and unmeaning ceremony, been appropriated as the nucleus of a fund towards a new façade to Guildhall, since nothing can be more detestable than the present one.

Engineers' Convention.—It is announced that the Chevalier de Weebeking, the engineer of the railways between Munich and Augsburg, Fürth and Nuremburgh, is about to issue a circular, inviting all the celebrated railway engineers to assemble at Munich, in the course of the present year, for the purpose of mutually communicating information on the construction and working of railways. We very much doubt the utility of such a meeting.

REVIEWS.

Domestic Architecture: containing Principles of Designing Public Buildings, Private Dwelling-houses, &c. &c. By RICHARD BROWN, Professor of Architecture. 4to. Part 1—13.

THERE are occasions on which to show lenity would argue either stupidity or dishonesty, rather than mercy; and most assuredly the present is one of them, for scarcely ever have we met with a more egregious specimen of arrant book-making, of quackery and charlatanry, than this publication. Of quackery and impudence the very title itself bears evidence, the author there assuming to himself the style of "Professor of Architecture!" Undoubtedly any man may call himself "Professor" of anything, if it so pleases him; yet, as custom does not warrant the use of the term as signifying no more than one who follows any particular trade or calling, the self-assumption of it is so far from conferring any respectability, that it is rather a sign of vulgar-mindedness, and low paltry artifice. Absurd at the very best, this kind of self-bestowed professorship becomes doubly or trebly so in the case of Mr. Richard Brown, since he might with equal propriety have signed himself Professor of Poetry. Whether he has any qualifications for setting up in the latter character, we know not; but we do know that he possesses none whatever for that of a professor of the other art, it being very plain that, instead of being at all capable of instructing others in architecture, he is most profoundly ignorant of it, even of its first rudiments, and the commonest principles of taste, and that he needs to go to school, though we question whether it would be to any purpose.

The work is altogether a very flagrant instance of "Catch-penny." —Why then, it will be said, bestow any notice on it? why drag it from its obscurity? why not pass it by with silent contempt?—Because it is, in our opinion, a very fit subject for castigation. The treating offenders of the kind merely with contempt, is nothing else than granting them impunity. What care they for contempt, who know themselves to be contemptible pretenders, and who are utterly indifferent to public opinion, that is, to the opinion of the intelligent, provided they can but impose upon the ignorant and credulous, and obtain their favour and patronage? Exposure they may dread, contempt they only mock at. We do not say that even exposure does much good, as far as correcting the offenders themselves goes; still it is attended with salutary effect, opening the eyes of the public, by putting them on their guard against productions of the kind, and by making others shy of risking similar castigation. Were publications of the kind merely worthless, they might be allowed to pass without very strict inquiry: but they are, on the contrary, positively mischievous, since they not only do not promote good taste, but diffuse the very worst, amongst workmen and mechanics. It is to trash of this kind, published under the name of collections of "Designs," that we may ascribe those abortions and monstrosities in brick and mortar, which spring up in various parts of the country. Instead of promoting the advancement of the art, they positively retard it; and instead of being at all creditable to any one concerned in them, they cast a sort of slur upon the whole profession, and tend to bring the very study of architecture into contempt.

It certainly is most mortifying to reflect upon the humiliating light in which foreigners must look upon the present state of the art in this country, if they judge of it,—as they are most likely to do,—from such publications as the present one and some others; more especially, if to their appearance be added the *non-appearance* of architectural works of a higher order, of which there certainly has been a great dearth of late, far more so than used to be the case when the profession was by no means so numerous as at the present day. Whatever may be the cause of this—whether it be partly owing to a very increased demand in this country for foreign architectural works, in preference to those of our own production—we pretend not to judge. Such is the fact; and it is one that has been stated by other writers, not without some degree of bitterness. Let the remote cause be what it may, there can be little doubt that the immediate one is the want of encouragement among us for works of the same class as are continually issuing from the publishing houses of France and Germany. Hardly is the profession any more lucrative on the continent than in this country, else that circumstance might be taken as a sufficient explanation of the matter; yet, such not being the case, we must leave our readers to account for it in the best way they can,—satisfactorily, if they can; although it is anything but satisfactory in itself.

At all events, it is deplorable enough that, while very inadequate encouragement is given to works which would be really creditable both to the art and to the profession, there should be any at all for the vamped-up, catch-penny productions, of which the one before us is so egregious a specimen. As for the literary portion, it consists either of mere scissors-and-paste work, or of the most irrelevant, far-fetched rigmarole, that can well be imagined, and a great deal of what, if not actually absurd in itself, becomes absurd, when *lugged in* for the nonce, as we here find it, without having any sort of connexion with the subject or the occasion. What, in the name of common sense, has the mention of antediluvian architecture, or meagre, schoolboy sketches of the history of Egyptian and other still less known early styles of antiquity, to do with modern "Domestic Architecture,"—more especially in a volume of designs for ordinary villas, or rather, of villanous designs of most extraordinary ugliness? Very far more discreet would it have been, to have omitted the mention of styles altogether, since the less people understand about them, the more likely they will be to tolerate those samples of them which the Professor here exhibits, and which most convincingly prove that he has not the very slightest knowledge of any one style whatever, his designs being actual burlesques upon the different styles they purport to exemplify. Evident it is also that he cannot yet copy the Grecian orders, for the three figures pretending to represent them are only monstrous caricatures. In fact, the drawing of all the plates is most atrociously bad, so bad as to be the only consolatory circumstance of all. Had the plates themselves been tolerably well drawn and engraved,—had they been, in young-lady phrase, "exceedingly pretty,"—we should have been almost in despair; but, as good luck would have it, they are so wretched in every respect, as to display the designs in unmitigated ugliness; consequently, the mischievousness of the work is so far neutralized. The designs now show themselves at the first glance to be utter trash; whereas, had they been flattered by the engraver,—had they been managed with a little taste and adroitness on his part, —the ignorance, the blunders, and the barbarous ideas they display, might perhaps have passed undetected by the class of persons among whom the Professor, or his publisher, looks for customers. As it is, no one, we feel morally assured, that is, no one who is not a candidate for Bedlam or some county asylum, will be ambitious of building for himself in the Brownean Florentine, Tudor, Flemish, Stuart, or any other style whatever, according to the learned Professor's notions of it. But, hold! the suspicion has just come across us, that, after all, the Professor is neither more nor less than a wicked, prankish wag, who, in order to discover how far gullibility will go, has here maliciously put forth a series of hoaxing, farcical caricatures, as examples of the respective styles, and perhaps as a covert satire on the affectation of imitating all sorts of outlandish styles, and that in the most barbarous manner. Certainly such must be his intention in regard to the specimen he has given us of the Grecian style, which partakes far less of Greece than it does of my grandmother; therefore, as the character of Grecian architecture is now tolerably well understood, he would hardly have ventured upon such an example, except as an obvious burlesque. In his design for an "Anglo-Grecian Museum," he makes a scurvy hit at Soane, caricaturing his architectural eccentricities most unmercifully; and, among other freaks, placing Ionic columns with the baluster side of their capitals outwards! The section of the building, in which this Anglo-Grecian peculiarity manifests itself, is further remarkable for the *scientific* construction of the roof, and for showing Doric columns with chamber-pot-shaped capitals supporting arches, another Anglo-Grecian peculiarity!—the said columns being very little higher than the hand-rail of the staircase. Lest the drift of the satire should by any possibility be misunderstood, this plate is entitled "Soanean Museum, section and component parts," the last being little better than the scrawls an idle boy would make upon his slate.

If he chooses to avail himself of it, we give the ingenious Professor the full benefit of our suspicion; but if he rejects it, we must set him down as one of the greatest ignoramuses that ever ventured before the public. It is really astonishing that a person who shows himself so thoroughly incompetent in every respect, so utterly destitute of every qualification, should have the effrontery to offer to the public a parcel of disgracefully miserable drawings,—so execrably vile, that it is incomprehensible how any respectable, or how any publisher at all, could be induced to touch them. It is possible that the latter party may have been imposed upon, and, owing to his own ignorance of the subject, has been led to that which, as a respectable and fair-dealing tradesman, he otherwise would have rejected with scorn, and not lent himself in any way to such a piece of impudent quackery.

However devoid of merit they may have been in themselves, we have generally been able hitherto to pick up a serviceable idea or hint, from productions of the kind. Not so, however, from Professor Brown's: his designs are as dull as they are hideous; they offer nothing whatever that can, by any possibility, be shaped to any purpose. His plans are about as absurd as his elevations; certainly most clumsy, and without any sort of study or contrivance; while, as to the few sections he has given, they are perfectly ridiculous; nor do they always correspond with the ground plans. If there be still a degree of worseness, a "lower depth within the lowest deep" of vileness, it is manifested in the details, or "component parts" of the accumulated deformity here presented to us.

That we are severe, we do not deny; but we cannot possibly be too severe, on the present occasion, for we hold this publication to be thoroughly disgraceful to all concerned in it, and nothing less than a positive insult to the architectural profession, and a libel upon the architectural taste of the country, in the middle of the nineteenth century. Far better architectural designs than those of this Professor may any day be seen at almost any confectioner's shop-window. They are in fact so supremely wretched, that it is utterly impossible to convey any idea of their preposterousness, by words alone; and were it not that it actually is published, we should say that no one in his senses would publish such execrable trash. It is matter of doubt with us after all, whether the Professor be really in his senses, for his drawings manifest as much insanity as did those of Messrs. Baddock and Buckland for the Houses of Parliament, which some of our readers will perhaps recollect, and which certainly struck with amazement all who beheld them. How far it is a proof of sanity, or the contrary, on the part of the Professor, that he intends to give his own portrait in the concluding number of his work, we leave our readers to decide. Probably he may be, or may fancy himself to be, a perfect Adonis; but unless his own face be very much better than his façades, he must be a perfect scarecrow.

London Bridge, Drawn by B. Albano, M. Inst. C. E. and M. R. I. N., and engraved by Lowry. London: Weale, 1842.

We have received a magnificent engraving of London Bridge, from the drawing of Mr. Albano, executed by Lowry in his best style, being one of the finest delineations of an engineering work which has yet appeared. This print, from a plate 3 ft. 6 in. by 2 ft., possesses an accuracy and fidelity which are the best qualities of such a work; while as a production of art it is truly splendid. As the engraving depends for its importance on the bridge itself, we think it better to give some account, from Mr. Albano's notes, of the dimensions of this triumphant monument of Sir John Rennie's skill.

The drawing was presented by Mr. Albano to the Institution of Civil Engineers; it was made with great care and accuracy, from dimensions taken by him during the progress of the works.

Centre arch 151 ft. 9 in. chord, 37 ft. 10 in. rise.
Piers on the side of centre arch each 24 ft. in width at springing.
Arches on either side of centre 140 ft. chord, 37 ft. rise.
Piers of land arches each 22 feet in width at springing.
Land arches on each side 130 feet chord, 33 ft. 10 in. rise.
Total length of bridge from face to face of abutments 783 ft. 9in.
Width of water way at spring of arches 691 ft. 9 in.
High water Trinity datum 8 ft. 4 in. above spring.
Low water Trinity datum 10 ft. 1 in. below spring.
Length of bridge from end to end of abutments 1005 feet.
Width of bridge from cut to cut 56 feet.
Width of carriage road 35 ft., of each foot path 9 ft.
Greatest depth of foundations 23 ft. 7 in. below low water datum.
Total number of piles, forming the coffer-dam 7708.
Total number of piles, 20 ft. long, under piers and abutments. 2092.
Quantity of granite and stone used in constructing the bridge and abutments, 120,000 tons.
First pile driven 15th March, 1824. First stone laid 15th June, 1825.
First arch keyed 4th August, 1827. Last arch 19 Nov. 1828.
Bridge completed and opened 1st August, 1831.
Cost of the bridge £542,150.
Cost of the bridge and approaches, including alteration and removal of old bridge, £1,401,234.

Examples of Inlaid Gothic Tiles. London: Nichols and Son, 1842.

This work comes very acceptably at a period when so much attention is directed to the details of architectural ornament. Encaustic tiles are to be met with extensively in our cathedrals and ancient churches; although it is only of late years that they have been re-introduced. Mr. Harvey Eginton was, we believe, the first to use them in 1837, in the repair of Stratford-on-Avon Church, and they have since been used at Wilmcote Chapel, near Stratford; St. Michael's, Worcester; St. James's, Malvern; the Temple and St. Mary's, Stafford.

The little volume before us contains engravings of twenty-four specimens of tiles, the size of the originals in Winchester Cathedral, Romsey Abbey Church, St. Cross, Winchester, Warblingam Church, and Worcester Cathedral. These illustrations are nearly all from Hampshire, so that as the mode of engraving is cheap, we hope to see similar works for other districts.

The editor of this volume has done considerable service by leading the way in the illustrations of such an interesting subject.

A Familiar Explanation of the Nature and Importance of Assurances upon Lives. By Lewis Pocock, F.S.A. London: Smith and Elder, 1842.

To professional men, more than to any other class of persons, the importance of life assurances is strikingly great. Too often, although in the receipt of large sums of money annually, they are led, by the necessity of maintaining an appearance in society, to expend their whole income, so that, in the event of death, their families would be left entirely unprovided for: whereas, by appropriating a portion of their revenue to assure the payment of a certain sum of money to their relatives, after their death, all solicitude is removed, and, in the words of the intelligent author of the book before us, "a safe termination to an uncertain event is secured."

Strange to say, the principle of life assurances is but little understood, their advantages but slightly appreciated. It is the object of Mr. Pocock's book to set the whole matter in a clear and familiar point of view, to explain the different systems of assurance now in use, and the routine required for effecting a policy. It likewise contains the principles, terms, and tables, of seventy London assurance offices, and forms altogether a perfect *vade mecum* for those wishing to understand, or desirous to avail themselves of the many advantages arising out of this very important species of assurance. We hope, as much for the sake of the public as of the author of this useful little book, that it will have a large circulation.

We have from Mr. Ferdinand Pelzer, *A Practical Guide to Pianoforte Playing*, of which we ourselves do not profess to be judges, notwithstanding the injunction of Vitruvius as to the intimate union of architecture and music. We have referred Mr. Pelzer's work to the female department, and are told that it is calculated to be useful to the young student.

ON THE DECORATED BUILDINGS OF LONDON.

While so much attention is being devoted to the introduction of the other arts into public buildings, it may be of advantage to the advocates of decoration to have a list, although an imperfect one, of those buildings in the Metropolis in which it has been already applied. Theatres and places of amusement it will be unnecessary to enumerate, so that we shall turn our attention to other edifices.

St. James's Palace has painted ceilings in most of the state rooms and staircases.

The ceiling of Whitehall Chapel, painted by Rubens, represents the apotheosis of James I.

The grand stair-case and ceilings of the principal rooms of Kensington Palace were painted by Kent.

The Painted Hall of Greenwich Hospital was executed by Sir James Thornhill, and the ceiling of the Upper Hall is also painted, representing Queen Anne and Prince George of Denmark, surrounded by various allegorical figures. The Chapel has been ornamented by the pencils of West and others.

The British Museum, now about to be pulled down, is too well known to require any description. The artists employed have been Charles de la Fosse, Jacques Rousseau, and Rigaud.

The dome of St. Paul's was ornamented by Sir James Thornhill with paintings illustrative of the life of St. Paul.

The Roman Catholic Cathedral of St. Mary, in Moorfields, is painted throughout.

The Duke of Beaufort's House was recently painted by Mr. Latilla and Mr. Owen Jones; descriptions of it will be found in the Journal.

The Hall of the Society of Arts is indebted to the pencil of Barry.

The Library of the Royal Academy has a painted ceiling by Angelica Kauffman.

The ceiling of the Library in the Soane Museum was executed by Howard the Academician.

The Reform Club is one of the most brilliant modern specimens, the whole of the decorations of which have been executed from the directions of the architect Barry.

The Hall of the Drapers' Company, in Throgmorton Street, is well arranged.

The stair-case of St. Bartholomew's Hospital, painted by Hogarth, at his own expense, represents the Good Samaritan and the Pool of Bethesda.

Many private houses have painted ceilings. That in Buckingham Stre where Peter the Great resided, the House of the Westminster Discou Company, the Linnean Society's House in Soho Square, &c.

COMPETITION DESIGNS.

Mr. Editor—By inserting the following account of a competition job, in your widely circulating journal, you will enable me to fulfil my promise to the perpetrators of it, and contribute something to the general tide of indignation against the system as now practised.

In June last the Commissioners appointed under an Improvement Act, advertised for designs for a Pump Room at Low Harrowgate, and stated, amongst other particulars, that no premium would be given, but that the architect producing the most approved design would be employed to carry it into execution. This bait drew designs from about twelve architects, all, like myself doubtless, expecting they would have fair play in return for their expenditure of time and talent. The designs were sent in, and the Commissioners met on the 16th of August following; the meeting was then adjourned to the 20th; and again to the 6th of September for final decision. Being at Harrowgate on the eve of the last named day, I was astonished to learn from several of the Commissioners, that Mr. Strutt, one of the competitors, and a native and resident at Harrowgate, had prepared *another* design, introducing a prominent feature of my own design (a dome) which had been privately handed round amongst the Commissioners, preparatory to its being introduced at the meeting for the final decision. Though I strongly remonstrated against this most dishonourable proceeding, the drawing was actually brought into the Commissioners' Room by one of the body, but the Reverend Chairman, together with some others, would not sanction it to be produced. On dividing, my design was rejected, and Mr. Strutt's chosen by a majority of five; after which I received the following note from the chairman.

"*High Harrowgate, September* 6, 1841.

"Sir—Being of opinion that the plan for the Harrowgate Pump Room has been decided not upon *merit*, but by favour, I beg to inform you that I have withdrawn my name from the list of Commissioners in consequence. It will not be unsatisfactory for you to know that I gave my vote in favour of your design, as in my judgment the best offered to the acceptance of the Commissioners, at the estimated cost prescribed in the instructions given by them.

"I remain, Sir, your obedient servant,
"To Mr. Mallinson, Architect, Thos. Kennion."
Brighouse."

And which was afterwards endorsed by two others of the Commissioners—

"Mr. Charlesworth expresses his perfect concurrence with the above remarks of Mr. Kennion."

"I also beg to give my testimony to the foregoing, and have withdrawn my name from the list of Commissioners in consequence.

J. G. Paley."

Captain Thackwray (who was prevented from indisposition from attending the meeting) and Mr. Dearlove subsequently withdrew their names for the same reasons. I understand the Chairman also addressed notes to *all* the excluded competitors, stating his opinion of the transaction.

The Rump (probably alarmed at this serious defalcation from its numbers and respectability) then attempted a compromise, and proposed that I should be joint architect with Mr. Strutt. To this I stated my readiness to accede, provided they would revoke their precious decision, and give the award to me. This being objected to, after freely expressing my opinion of their conduct, I took my leave, not without the hopes expressed, after a long interval (for reasons therein stated) in the following :—

"To the Commissioners appointed under the Harrowgate Improvement Act.

"Gentlemen—I have hitherto been silent on the subject of the architectural competition for the Pump Room, Harrowgate, hoping that due reflection, and the secession of five of the most influential members of your commission, would have led you to reverse the partial and most unjust decision, by which a majority of your body rejected my design.

"The letting of the works and laying of the stone have been managed with a secrecy so unusual in such cases, that I have seen no notice of either in any public print. Your advertisement for a loan, a few weeks ago, led me to make inquiries, which have informed me of the commencement of the building, and the consequent futility of my expectations.

"Presuming you to be not indifferent to the good opinion of your fellow-townsmen, and wishful to pass for men of character and honesty, you are bound to disprove the charge made against you in the note addressed to me by the Chairman and other retiring Commissioners, a copy of which I herewith enclose. It is due to myself and the other competitors, as well as to the profession generally, that the particulars of this unprecedented transaction should be made as public as possible. I, therefore, ask you for copies of the design first sent in by Mr. Strutt, which you selected as the best; also of the one now being carried into execution (which I presume to be the amended one sought to be substituted in place of the first one, *before* the competition was decided!), in order that I may publish them together with my own design, and thus afford the public an opportunity of judging between us. I need not add that your refusal to comply with this request will be a tacit admission of the correctness of the charge.

"I remain, Gentlemen, your very humble servant,
"*Brighouse, near Halifax*, "James Mallinson."
December, 27*th*, 1841."

This produced the following reply—

"*Committee Room, Harrowgate, Dec.* 27, 1841.

"Sir—I am requested by the Commissioners, in reply to your letter applying for copies of Mr. Strutt's plans for the Pump Room at Low Harrowgate to inform you that they cannot comply with your request; and, that they do not consider you have any right to ask for them.

"I am, Sir, yours obediently,
"S. Powell, Jun."

Being thus for the present deprived of the benefit of the comparison, I am compelled in some degree to be both plaintiff and judge. But having seen all the designs, I can conscientiously affirm, that, with perhaps *one* exception, the approved design was the most unsuitable for the situation. Several designs of merit were cast aside, almost without examination, for the whole and sole reason, that their estimated cost exceeded the stipulated sum of £1,500, and yet this approved design was estimated to cost only £1,900 ! ! ! What the amended design may be I know not, but I intend to send you a sketch of it when completed, also of the original one, of which I have a sketch from recollection, made immediately after seeing it, together with my own, that you may judge of the correctness of my assertions; meantime,

I remain, Mr. Editor, your very obedient servant,
James Mallinson.

P.S. One of your correspondents suggests, that in such cases the names and occupations of the parties should be given. I consider his suggestion a good one, and give them, first apologising to my supporters for placing their names in a company they have so long repudiated.

For.

Reverend Thos. Kennion, Incumbent of High Harrowgate Church.
John Green Paley, Esq., Magistrate.
Charles Charlesworth, Esq., Gentleman.
Mr. John Dearlove, Innkeeper.
Mr. Nicholas Carter, Wine Merchant.
Mr. Thomas Gordon, Proprietor of the Cheltenham Pump Room.

Against.

Mr. Jonathan Benn, Retired Innkeeper.
Mr. Thomas Hall, Innkeeper.
Mr. George Hobkinson, Milkman and Boarding Housekeeper.
Mr. George Knowles, Plumber.
Mr. George Morely, Baker and Grocer.
Mr. George Harper, Innkeeper.
Mr. Richard Stanning, Innkeeper.
Mr. Joseph Waite, Druggist.
Mr. Richard Whincup, Porter Dealer.
Mr. Christopher Wright, Coach Builder.
Mr. J. H. Walker, Wine Merchant.

RAILWAY WHEELS.

Mr. Phipps, of Deptford Green, Engineer, has obtained a patent for improvements in the construction of railway wheels, the object of which is to supersede the process of "shrinking on," which he proposes to do in the following manner :—

A bar of wrought iron is prepared, by rolling in the usual manner, with an outer flange on one edge, and an inner flange in the centre of the bar; this bar is bent into a circular form, and then welded. Sixteen wrought iron spokes are prepared, with an extended end or palm, which may be drawn out by hammering, or welded on; the inner end of each spoke is jagged or perforated, in order that the cast metal may embrace and hold it fast. Eight of these spokes are then laid in a mould, and one portion of the boss or nave of iron cast upon thier inner ends; the other eight spokes have the corresponding portion of the boss or nave cast upon them. The two parts of the nave are then brought together, and secured by screw bolts, and the enlarged ends or palms of the spokes strongly secured to the alternate sides of the inner flange by screw bolts, or by rivetting. Another method consists in placing all the spokes in their respective positions around the wheel, and casting the boss or nave in one piece, the palms of the spokes being afterwards rivetted to the inner flange.

Another patent has been granted to William Losh, Esq., of Little Benton, Northumberland, for improvements of railway wheels, by the application of wood, felt, rope, or other such like flexible or yielding material, between the inner tire and the ring or felloe, or bearings produced by the prolongations of the bars of iron employed to make the wrought iron spokes, with or without the intervention of a ring of malleable iron between such bearings and such flexible or yielding material; by which means wrought iron railway wheels will be less liable to be prejudicially acted on by the vibration to which such wheels are liable when in use, than if they were composed of iron alone. The wheels to which these improvements are applicable, are those included in the patentee's former patent, of August, 1830.

SUPPLY OF PARIS WITH WATER.

An Englishman of the name of Miles has addressed a memorial to the French authorities, on the subject of a proposed supply of water to Paris. Some of the statistical facts put forward may interest our readers. The city of Paris, he observes, possesses very peculiar advantages for such an undertaking. In London, the quantity of water consumed daily is 168,826 cubic metres (French) for 191,066 houses. In Paris there are about 40,000 houses, which is little more than one-fifth of those in London. The expense of pumping by steam-engines this quantity of water from the level of the Thames at London, to an elevation equal to the Canal de l'Ourcq, above the Seine, would cost £69,000 per year, the whole of which would be saved by a supply from the Canal de l'Ourcq. The houses in Loudon may be calculated at six persons each, making a population, in 191,066 houses, of 1,146,396 inhabitants. The 40,000 houses in Paris contain 909,126 inhabitants, equal to 22 or 23 to each house, or of four families of six persons each. The length of the pipes required for Paris will not exceed a fourth part that of London, and their dimensions will be less, on account of the descent of the water affording a greater velocity. The exact length of pipes required cannot be stated without a plan and section of all the streets—it is probable that the length required would measure about 170 English miles. If this quantity of iron pipes were delivered at £20 sterling per ton, it would amount to the

sum of	£480,000
The expense of laying, with the apparatus of cocks, &c., for service, may be stated at	120,000
Making a total of	£600,000

Supposing 10 per cent. interest, the sum to be paid annually would be £60,000. At present, it is allowed that Paris pays annually for the purchase of water, not exceeding 50 litres per day for each house, £160,000; so that, upon the present rental, a saving would take place of £100,000 per year, and the inhabitants would receive the most abundant supply of water. M. Girard estimates the quantity of water supplied by the Canal de l'Ourcq at 260,820 cubic metres per day. Supposing this calculation to be exact, it will be necessary, first, to deduct all the water necessary for the supply of the present public fountains and markets; and secondly, what is consumed by the locks on the Canals St. Martin and St. Denis, which may be calculated at 1,054 cubic metres for the passage of a barge, or of 105,400 cubic metres for the passage of 50 barges on the two canals. The quantity of water consumed daily in each house in London, in 1810, before the establishment of the new water companies, did not exceed 50 gallons, but since that period the consumption has reached 200 gallons (?) per house per day. This includes manufactures, baths, &c. If a similar increase in the consumption should take place in Paris, the quantity required would be 140,000 cubic metres per day, for the use of the 909,126 inhabitants. London pays annually for water the sum of £284,188, averaging about 32*s*. (58) per house for six persons; consequently, if Paris were called upon to pay £60,000 per year, it would average about eight shillings for every family of six persons for an equal supply. When plans and sections of the streets shall be made. the engineer-in-chief will be able to construct a system of perfect drainage, parallel to the water-pipes, and of the same inclination.—*Athenæum.*

THE PALMIPEDE.

We have a long account in the *Morning Post* of a newly-invented locomotive power. (the invention of the Marquis de Jouffroy,) said to be applicable to steamers, from which we select the following extracts, describing this *wonderful* invention; but to our dull comprehension it appears to be a "mountain in labour":—

"The scientific world will readily appreciate the justness of the principles, according to which the Marquis de Jouffroy constructed his machinery, and applied it with complete success, as we can asssert, to a schooner of about 120 tons (French) burden, rigged as usual, like a sailing vessel. Her measurement is as follows:—

"Twenty metres 15 (62 feet French) from stem to stern, and 5 metres 20 (16 feet French) beam; drawing when laden two metres forward, and two metres 37 abaft; the area of the parallelogram of the portion immersed amid-ships, 11 metres square, although, on account of the build of the ship's bottom, this area is really but seven metres square. She carries a steam-engine, mean pressure, of from 20 to 40 horse-power, *ad libitum.*

"*Abaft* the vessel, on deck, is a platform four metres long, moving horizontally on a vertical axis fixed in the stern-post, one half of the said platform being without the vessel, and the other half within; the latter sustains the two oscillating cylinders of the steam-engine, the piston-stems of which communicate the movement, in a direct manner, to an iron arm fixed to the platform outside the vessel. This arm is composed of five cranks, two of which receive the extremity of the pistons, the three others, articulated by means of double cranks to the levers, serving as a fulcrum in the fluid. Three couples of these levers are suspended from pivots at the exterior extremity of the platform; these act parallel to the course of the vessel, and carry articulated palms, three in number, which reach to the level of the keel, each presenting to the fluid, at the moment of pressure, a surface of two metres square. After each impulse forwards, these palms close of themselves to return, and open again only to give the next impulse.

"The cranks of the pistons being fixed according to two planes, each at a right angle with the other, the moving force is nearly equally distributed during one evolution of the articulated arm; but, by the arrangement of the double cranks which commuuicate to the articulated palms, each of these exercises its pressure upon the fluid during only one-third of the evolution, and the maximum of this pressure takes place in a very short space of time the remaining two-thirds of the evolution are taken up in the return and in the opening of the palms.

"Although the technicality of the above description may render a conception of the new invention rather difficult at first sight, its effects may be easily conceived by imagining the backward and forward motion of two webbed palms, propelling a vessel forwards, one palm opening and moving parallel to her course, whilst the other, having performed its functions, closes by the pressure of the fluid acting on the articulations, and returns to its place in a direction opposite to the vessel's course, again to advance when its companion is on the point of returning, having in its turn performed its office."

ACADEMY OF SCIENCES.

Dec. 20.—Announcement was made of the completion of the great Geological Map of France, by Messrs. Dufresnoy and Elie de Beaumont. It was commenced in 1823, under the direction of the late M. Brochant de Villiers; eleven years were occupied in geological researches *in loco*, and the other seven years in the classification of materials, in drawing, engraving, &c. The map, divided into several sheets, is now published, with a volume of descriptive letter-press.

A report was read on the works undertaken by Dr. Fontan and M. François, engineer, for improving the thermal sources at the Bagnères de Luchon, in the Pyrénées. By driving horizontal galleries into the rock, near the old mouths of the sources, they had succeeded, not only in obtaining water in great quantity, but also of greater heat. Some of the old springs have dried up in consequence, but the general improvement of the springs was very great, and it had been accomplished at a cost of only 30,000fr. The works lasted two years.

A series of observations and questions was addressed to the Academy, from the Minister of Marine, on the natural history of the silk-worm, with propagating the growth of silk in the West Indies. M. Perottet had been sent out to examine into the best means of promoting this object. This gentleman had remarked that silk-worms' eggs carried to the West Indies from France, and kept in those hot countries for seven or eight years, could not be hatched until the end of eight or nine months, notwithstanding the high temperature, and then only at long and irregular intervals; but when the same eggs were put in an ice-house for four or five months, they were hatched within ten days from their being exposed to the circumambient atmosphere, and nearly all at once. Directions for the proper treatment of worms under these circumstances were demanded of the Academy. The subject was referred to the Section of Rural Economy.

The greater part of this day's sitting was occupied with the reading of medical and anatomical papers.

THE RIVER CLYDE NAVIGATION.

In the "*Glasgow Argus,*" of the 6th ult. we find an address presented to the Owners of the Steam Boats on the River Clyde, to the Trustees; wherein is mentioned that the steamers on the River Clyde carrying passengers have competed most successfully with the New Railway running parallel with the Clyde, from Glasgow to Greenock. The following is an abstract of the address.

Gentlemen—The first season since the opening of the Greenock Railway having terminated, we beg to apprise your honourable Board of the comparatively great and almost unlooked-for success which has attended the River traffic during the summer months, notwithstanding the formidable opposition we have had to encounter, in our novel and confessedly powerful competitor. * * * We beg specially to express our gratitude for the invaluable boon conferred on us, in authorising the river steamers to arrive at and depart from the New Wharfs, adjoining the Glasgow Bridge, and which we have no hesitation in stating has been the means of *entirely saving* our River trade! * * * Seeing the resolution by which this grand measure has been effected was passed unanimously at your Board, we feel that it would be almost invidious to particularize any individual as being more serviceable than another in carrying that resolution into practice. Yet, while we know that we are deeply indebted to every member of the Trust individually, we cannot close this address without adverting in marked terms to the great exertions and personal sacrifice made by James Hutchison, Esq., as contributing in a very eminent degree to the success of the new arrangements. The almost daily attendance of this gentleman at the new wharfs for a considerable period about the time of their opening, striking evinced the warm interest he felt in the object for which they were erected. We would beg most respectfully also to notice the unremitting diligence, and skilful co-operation of your invaluable river engineer, Mr. Bald. The care and attention with which he studied the working of his plan in all its bearings,—carried into effect whatever suggestings he judged likely to be useful, and in every possible way devoted his time and his talents to the furtherance of this new undertaking, are above all praise, and will not soon be forgotten by any of our number.

* * *

It is not for us to hazard any opinion as to the egregious folly of laying a line of rails along the margin of such a noble and magnificent river as the Clyde. We only know that, with your continued co-operation and support, we have nothing whatever to dread from any such uncalled-for competition. On the contrary—confident of success as heretofore—we can now fearlessly bid defiance to this new rival conveyance, with all its boasted advantages, and have no doubt that the Clyde, in every branch of its traffic, shall still as powerfully as ever contribute to the prosperity of Glasgow!

MISCELLANEA.

Lake of Como.—In the *Eco della Borsa* of Milan, there is an account of an experimental trip, made on the 15th November last, of the iron steam boat *Sirene*, constructed for and under the superintendence of Mr. B. Albano, C.E., of London, for the navigation of the Lake of Como. She is 105 tons burden, and was built in England by Messrs. Ditchburn & Mair, and fitted with a pair of beam engines of only 16 horses power each, by Messrs. Rennie. The following account is taken from the report of M. Caronti of Como (agent to the Steam Boat Company) to the directors at Milan. After a minute examination of the boat and engines by M. Albano, who made the required arrangements for a trial, the boat left the Olmo and arrived at the point of the town of Torno, a distance of 5 miles, in 25 minutes, and in 5 minutes more it reached the Pliniana with a strong head wind, and returned direct from the point of Torno to the port of Como in 20 minutes. At the first experimental trip made on the 14th of October last, with the directors and a party on board of above 100 persons, the boat performed then a journey from Como to Domaso, a distance of more than 30 miles, in 2 hrs. 40 min., and from Domaso to Como in 2 hrs. 35 min., the engines making from 37 to 39 strokes per minute, and the boat remaining very steady in the water. With such small power this boat has done wonders, and it will prove a great desideratum to the travellers on the Lake, who have been used to travelling by the old steam barge, running at a speed of only 4 miles per hour.

Ireland.—A Presbyterian church has been erected at Portaferry, on the site of the former edifice, from the designs, and under the immediate superintendence of Mr. Millar, architect. The difficulty of the site (being a piece of sloping ground, at least 10 feet in 100) with which he had to contend, has, in this instance, been changed into a positive and original beauty, such as does not exist in any public building that we are acquainted with in the three kingdoms. The first story, or body of the house, as it is usually termed, is contained in a stylobate, eleven feet high, or massive pyramidical basement, off which rises the columnar edifice. The lower portion of the building is entered from the south end, through a vestibule on the same, or lower level, on which this stylobate rests. On the north end, the stylobate returns east and west, forming an elevated terrace level with the back gallery entrance, and a higher part of the street, thus giving space large enough for a carriage to turn with ease, at the north propylæum, which presents a front of six elegantly proportioned and massive Doric columns. The intercolumniations of the four centre ones, and returns to their antæ, are filled up to about one third of their height with thin freestone slabs of large superficial extent, reaching from column to column; the remaining two-thirds being filled with glazed cast metal sashes of an exceedingly light description; thus giving, by this simple, though unique expedient, the great advantage of seeing the columns, internally as externally, which, by their undecorated finish, give the whole edifice the effect and proportion of simple, yet classic beauty. In a parallel line to these, at nine feet farther back, stand Ionic columns in antœ, sustaining a vast beam, forming a marginal line to the ceiling of the house, which is richly coffered; the four angular coffers being filled with ornamental ventilating centres of elaborate workmanship, and chaste design. At the south end a similar screen extends from column to column, separating the vestry from the body of the church, against which is placed the pulpit, in form of the ancient rostrum, supported on massive scroll trusses, projecting from the wall, and finished in Sienna marble, so as to harmonize with the galleries and its antœ in colour, it being part and parcel of the general design, connecting them from right to left.

The style of architecture which Mr. Millar has adopted for the very peculiar site, is that which prevailed in Greece during the architectural age of Pericles; its dimensions are sufficiently large to produce an impression of grandeur and sublimity, which is not disturbed by any division of parts; and whether viewed closely, or from the opposite shores of Strangford, there is nothing obtrusive to divert the mind of the spectator from contemplating the unity, as well as the majesty of mass and outlines—circumstances which form the first and most remarkable characteristics of the great prototypes erected during the purer age of Grecian art, on which the architect has evidently founded his studies; thus stamping his works, where they have been carried out under his own eye, with perfection and harmonious beauty, without stooping to the factitious aid of adventitious embellishment. We would fain hope that such buildings as this, erected from the designs of a professional man, may serve as a stimulant in directing public attention to this too much neglected subject, and particularly in rousing the self-esteem of members of all religious establishments.—*The Downpatrick Recorder.*

King's College.—Mr. Hoskings, on Tuesday, the 25th ult., delivered his introductory lecture on the principles and practice of architecture, in which he dwelt at length upon the importance of attending to construction, and concluded by offering some advice to the architect on making competition designs.

Woolwich.—On the 3rd January, the master shipwrights, Mr. Oliver Lang, of Woolwich dockyard, Mr. John Fincham, of Chatham dockyard, Mr. James Atkins, of Sheerness dockyard, Mr. Richard Blake, of Portsmouth dockyard, Mr. Thomas F. Hawkes, of Plymouth dockyard, and Mr. Roberts, late of Devonport dockyard, assembled at Woolwich dockyard to decide upon the plans which it would be most desirable to adhere to in future, as a fixed principle for building vessels for Her Majesty's navy. This resolution on the part of the Admiralty will prevent all chances of difference of opinion on such matters, and prevent the possibility of the work of one master shipwright being altered or condemned when the vessel is sent to any other dockyard than the one where she was constructed for repair, which has sometimes been the case on former occasions. One fixed principle of shipbuilding at all Her Majesty's dockyards will be attended with very beneficial results to the service, and it would be advantageous were the master shipwrights to meet annually, or oftener, to take into consideration such discoveries as might be made owing to the present advanced state of scientific knowledge.

French Line of Steam Ships to New York.—France and the United States are to be more nearly allied by a line of steamers. The *Courrier des Etats Unis* says that M. D'Aubigny, captain in the French navy, recently arrived at New York, had been sent hither by the Minister of Marine, for the special purpose of investigating the actual condition of steam navigation in the United States, and of studying the improvements that have been made. M. D'Aubigny is of opinion, that the close of 1842 may be assigned as the time at which a first line of four steam-packets, between Havre and New York, may be put in operation. Vessels it is said, are already in a forward state of progress, of the war model, but so constructed as to serve admirably, in time of peace, for the transport of goods and the conveyance of passengers. They will be commanded by officers of the navy, as the English vessels are. Their capacity is to be about 1200 tons, and their power 500 horses. M. D'Aubigny will set out, in a few days, for the south, whose principal rivers and seaports he will examine. He has given minute attention to the steam frigates Missouri and Mississippi, at the Navy yard on Long Island.—*New York paper.*

The Steam Engine.—M. Delecluze has lately made a discovery among the manuscripts of Leonardo da Vinci, carrying back a knowledge of the steam-engine to at least the 15th century. He has published, in the *Artiste*, a notice on the life of Leonardo da Vinci, to which he adds a fac-simile of a page from one of his manuscripts, and on which are five sketches with the pen, representing the details of the apparatus of a steam-gun, with an explanatory note upon what he designates under the name of the "Architonnerre," and of which note the following is a translation:—"Invention of Archimedes.—The Architonnerre is a machine of fine copper, which throws balls with a loud report and great force. It is used in the following manner:—one-third of this instrument contains a large quantity of charcoal fire. When the water is well heated, a screw at the top of the vessel, which contains the water, must be made quite tight. On closing the screw above, all the water will escape below, will descend into the heated portion of the instrument, and be immediately converted into a vapour so abundant and powerful that it is wonderful to see its fury and hear the noise it produces. This machine will carry a ball of a talent in weight." It is worthy of remark, that Leonardo da Vinci, far from claiming the merit of this invention for himself, or the men of his time, attributes it to Archimedes.—*Galignani's Messenger.*

The Milan and Monza Railway.—We have seen a report from Mr. Scott, the locomotive engineer of the railway, to Mr. Albano, C. E., who is superintendimg the construction of the locomotive engines in the country for the above railway, stating "that no engine that he had yet seen at all approached the locoMotive engine "*Lambro*," in any respect whatever; in the economy of fuel, in her immense dragging power, and in the excellency and the solidity of her framing, and working gear." This engine was built by Messrs. G. and I. Rennie, under the directions of Mr. Albano. She has cylinders 13 in. diameter; 18 in. stroke; 5 ft. 6 in. driving wheels; weight 22 tons; steam pressure 50 lb.; average velocity 36 miles per hour; weight drawn 143 tons. She commenced running on the 24th June last. The following account shows the very small quantity of fuel consumed each journey:—

June 24, 1841.	140	miles,	coke consumed	5612 lb.,	or 40lb.	per mile.
" 29,	140	"	"	4612	33	"
Sep. 8,	180	"	"	3800	22	"
Nov. 1,	120	"	"	2634	22	"

Palmer's Patent Electrotint.—We have just seen some proofs printed from plates prepared by a process for which Mr. Palmer, of Newgate-street, has taken out a patent. The proofs which we have seen are a dog's head, by Mr. T. Sampson; a study of a head by Wilkie, by Mr. T. Sampson; a fisherman, sketched by the same artist; and a fruit piece by Mr. G. Lance. This method of preparing copper plates and obtaining printed copies is called "electrotint;" and the following description of it, in the words of the inventor himself, will best explain its nature and capabilities of application. "The name of "Electrotint" is given in distinction from "Electrotype" to this invention, the latter being produced from engraved plates, whereas the electrotint plates are deposited, by the electrotype process, upon paintings made by artists upon a white metallic surface, with a composition resembling black paint. In the white portions of the design the surface is left uncovered, and the composition used sparingly in the middle tints; but where dark or black portions occur, it is laid on thickly and roughly.—The electrotint plates will of course be covered with indentations corresponding with the projections of the composition, which will receive the printing ink in proportion to their depth, and convey it in printing to the paper. The above plan is reversed to apply to printing from raised surfaces, such as wood blocks. A smooth black surface is chosen, and a white composition laid on with a stiff brush, &c. All those portions where the black surface is made to appear through the composition will, in the electrotint plate, project sufficiently to receive the ink from the printing roller, and transfer impressions to paper." It will be seen that artists, by adopting this method, can transfer to the copper or wood-plates, and thence to paper, copies minutely correct of their own peculiar styles of handling, and, as it were, rivet indelibly facsimilia of the spirit of their original compositions. The four prints we have seen are exceedingly beautiful; they are clear and brilliant, and free from that appearance of soot in the shadows by which lithographic prints, &c., are occasionally disfigured.

The new invention is yet in its very infancy, but from what it has already developed of its powers, it may be safely foretold that it is likely to attain a speedy and a lasting maturity in the history of the fine arts.—*Times.*

Preservative for Water colour Drawings and Engravings.—Mr. Spilsbury, of Pall Mall, has invented a solution for washing over water colour drawings and engravings, which preserves them from the action of the atmosphere, and at the same time allows them to be washed the same as an oil painting, a great desideratum; it is deserving of a trial by those who wish to preserve their engravings, without going to the expense of plate glass.

Ede's Portable Chemical Laboratories.—They are very compact cabinets, fitted with a great variety of tests and re-agents, glass tubes, blow pipes, and other appendages necesssary for performing numerous experiments.

OBITUARY.

Died, on Thursday, the 13th ult., at his residence, near Plymouth, J. Foulston, Esq., M. I. B. A., aged 69. Th edeath of Mr. Foulston cannot fail to excite a melancholy interest, in these towns and their neighbourhood, with which his name as an architect is almost as much connected as that of Wren with the city of London. Before his arrival among us, we had been for centuries in darksome ignorance, as to the meaning and merits of architecture. The success of Mr. Foulston, in his competition for the Royal Hotel and Theatre, fortunately established him as our resident architect; and his subsequent labours for many years were directed to the improvement and adornment of the three towns, naturally promoting that advance of the public taste, which is now manifesting itself in a general feeling for the "beautiful." The simple magnificence of our Hotel exterior, majesty of the Portico to the Devonport Town Hall, and the classic elegance of the Athenæum, and Plymouth Library, bear ample testimony to the distinguished merit of Mr. Foulston, as a disciple of the Grecian school; while his abillty and taste in treating the other varieties of design are shown in the Gothic Chapel of St. Paul, Stonehouse, and the Egyptian and Moorish buildings of Ker-street, Devonport. The monumental column in the latter town is also a pure and striking example of the architect's feeling for Greek simplicity. And we would suggest that this especially should be individualized as his monument, by an inscription to his honour, cut on a brass or marble slab, and let into one of the panels of the pedestal. Mr. Foulston was buried in St. Andrew's New Cemetery, on Tuesday, the 18th ult.—*Plymouth Paper.*

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 24TH DECEMBER, 1841, TO 27TH JANUARY, 1842.

Six Months allowed for Enrolment.

William Robinson Kettle, of Waterloo-street, Birmingham, Warwick, accountant, Benjamin Wakefield, of Ryland-street, North, Birmingham, civil engineer, and William Crosher, of Cumberland-street, Birmingham, aforesaid, screw manufacturer, for "*an improved bolt for building, and other purposes.*"—Sealed 24th December.

Montagu Macdonogh, of St. Alban's-place, Middlesex, gent., for "*improvements in spindles, flyers, and bobbins, for spinning, twisting and reeling all sorts of fibrous or textile substances, and in the application or adaptation of either, or all of them, to machinery for the same purposes.*" (A communication.)—Jan. 6.

Edward Hall, of Dartford, civil engineer, for "*an improved steam boiler.*"—Jan. 11.

Samuel Hearne Le Petit, of St. Pancras-place, St. Pancras-road, for "*certain improvements in the manufacture and supply of gas.*" (A communication.)—Jan. 11.

James Chesterman, of Sheffield, mechanist, and John Bottom, also of Sheffield, aforesaid, mechanist, for "*certain improvements in tapes for measuring, and in the boxes for containing the same.*"—Jan. 11.

Charles Wye Williams, of Liverpool, gent., for "*improvements in the construction of furnaces, and effecting combustion of the inflammable gases from coal.*"—Jan. 11.

John Tresahar Jeffree, of Blackwall, engineer, for "*improvements in lifting and forcing water and other fluids, parts of which improvements are applicable to steam engines.*"—Jan. 11.

Richard Dovor Chatterton, of Derby, gent., for "*improvements in propelling.*"—Jan. 11.

James Ions, of Newcastle-upon-Tyne, gent., for "*improvements in smelting copper ores.*"—Jan. 13.

Julius Bordier, of Austin Friars, merchant, for "*improvements in preparing skins and hides, and in converting them into leather.*"—Jan. 13.

Caleb Bedells, of Leicester, manufacturer, and Joseph Bedells, of the same place, assistant to the said Caleb Bedells, for "*improvements in the manufacture of elastic fabrics, and articles of elastic fabrics.*"—Jan. 13.

Joseph Barnes, of Church, near Accrington, Lancashire, manufacturing chemist, for "*certain improvements in the working of steam engines.*"—Jan. 13.

Henry Waterton, of Winsford Lodge, Chester, Esq., for "*improvements in the manufacture of salt.*"—Jan. 13.

John Jeremiah Rubery, of Birmingham, umbrella and parasol furniture manufacturer, for "*improvements in the manufacture of a certain part of umbrella and parasol furniture.*"—Jan. 13.

Moses Poole, of Lincoln's-inn, gent., for "*improvements in the construction of locks.*" (A communication.)—Jan. 15.

John Thackeray, of Nottingham, lace thread manufacturer, for "*improvements in the process of preparing and gassing thread or yarn.*—Jan. 15.

Thomas Lambert, of Regent's-park, musical instruemnt maker, for "*improvements in the action of cabinet piano-fortes.*"—Jan. 15.

Edward Palmer, of Newgate-street, philosophical instrument maker, for "*improvements in producing, printing, and embossing surfaces.*"—Jan. 15.

James Cole, of Youl's-place, Old Kent-road, brush manufacturer, for "*improvements in the construction of brushes.*"—Jan. 15.

Cornelius Ward, of Great Tichfield-street, musical instrument maker, for "*improvements in flutes.*"—Jan. 18.

William Tindall, of Cornhill, ship owner, for "*a new and improved method of extracting or manufacturing from a certain vegetable substance, certain materials, applicable to the purposes of affording light and other uses.*"—Jan. 19.

Antoine Mertens, of the London Coffee-house, publisher, for "*improvements in covering surfaces with wood.*" (A communication.)—Jan. 22.

William Baker, of Grosvenor-street, Grosvenor-square, surgeon, for "*improvements in the manufacture of boots and shoes.*"—Jan. 27.

John James Baggaly, of Sheffield, seal engraver, for "*improvements in making metallic dies and plates for stamping, pressing, or embossing.*"—Jan. 27.

Andrew Kurtz, of Liverpool, manufacturing chemist, for "*improvements in the manufacture of artificial fuel.*"—Jan. 27.

Francis Marston, of Aston, in the county of Salop, Esq., for "*improvements in apparatus for making calculations.*"—Jan. 27.

Samuel Mason, of Northampton, merchant, for "*improvements in clogs, —part of which improvements is applicable to shoes and boots.*"—Jan. 27.

Gottlieb Boccius, of the New-road, Shepherd's Bush, Gent., for "*improvements in gas, and on the methods in use, or burners for the combustion of gas.*"—Jan. 27.

William and John Galloway, and Joseph Haley, of Manchester, engineers, for "*improvements in machinery for cutting, punching, and compressing metals.*"—Jan. 27.

Pierre Journet, of Dean-street, Soho, engineer, for "*improvements in steam engines.*" (A communication.)—Jan. 27.

Henry Benjamin, of St. Mary-at-Hill. fish factor, and Henry Grafton, of Chancery-lane, machinist, for "*improvements in preserving animal and vegetable matters.*"—Jan. 27.

TO CORRESPONDENTS.

The American Pile-driving machine.—We neglected to mention in our last number, that this machine had been patented in this country, as well as on the Continent, by Col. Cowdin and others. We have received two communications on the subject of the table on the force of falling bodies, questioning the accuracy of the formulæ upon which the calculations were made. These communications we have deferred until next month, in order that we may in the mean time make some practical experiments on the force of falling bodies, which appears up to the present time to have been neglected by all our mechanical writers.

Bunnett's Patent Railway Breaks and other improvements.—We had intended to have given drawings and descriptions of these in the present number, but we have been prevented, in consequence of the wood engraver not being able to get the cuts finished in time.

J. M. on Architectural Precedent will appear next month.

We shall be glad to hear again from "Oliver Twist."

Sandstone.—We will notice his communication in the next Journal.

Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," *No.* 11, *Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th. instant.

Vols. I, II, III, and IV, may be had, bound in cloth, price £1 each Volume

ERRATA.

In Mr. Weale's advertisement of last month, the price of Buchanan's Mill work was printed 2*l.* 5*s.* instead of 2*l.* 10*s.*

On the Use of Gold for Decoration, page 7, line 7 from bottom, for *finely paid*, read *firmly fixed.*

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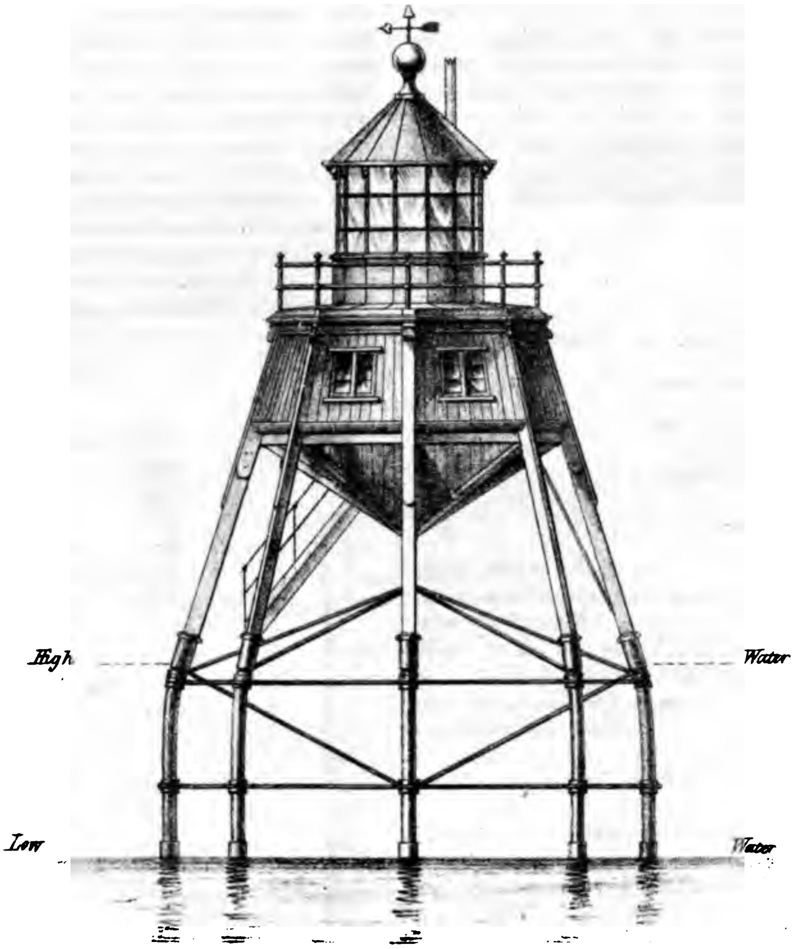
MAPLIN SAND LIGHTHOUSE.



South Elevation.

Light 45 Feet above the mean Level of the Sea
first exhibited on the night of the 10th Feby 1841.

Scale 0 10 20 Feet.

Printed by J.R. Jobbins, 3, Warwick Ct

THE MAPLIN LIGHTHOUSE.

ENGINEERS, MESSRS. WALKER & BURGES.

(With an Engraving, Plate III.)

In the second volume of the Journal, page 38, we announced the commencement of this lighthouse, and at page 132 of our last volume, we had the pleasure to notice its completion. We then gave some account of its construction, to which we must now refer our readers. The lighthouse, since its completion in October, 1840, has stood the test of several severe gales, and is at this day as firm as when first erected. Coupling this with the equal success of the Fleetwood lighthouse, it is in our opinion an indubitable proof of the utility of the screw pile system, and of the resources which it presents to the engineer in the construction of lighthouses on sands, in the place of floating beacons as now adopted, which are so apt to drive from their moorings in stormy weather, and which then produce such disastrous consequences.

The annexed engraving is a correct view of the lighthouse, and clearly shows its construction.

PEN AND PENCIL SKETCHES IN POITIERS AND ANGOULÊME: WITH SOME REMARKS ON EARLY ARCHITECTURE.

By GEORGE GODWIN JUN., F.R.S., &c.

Chapter 1.

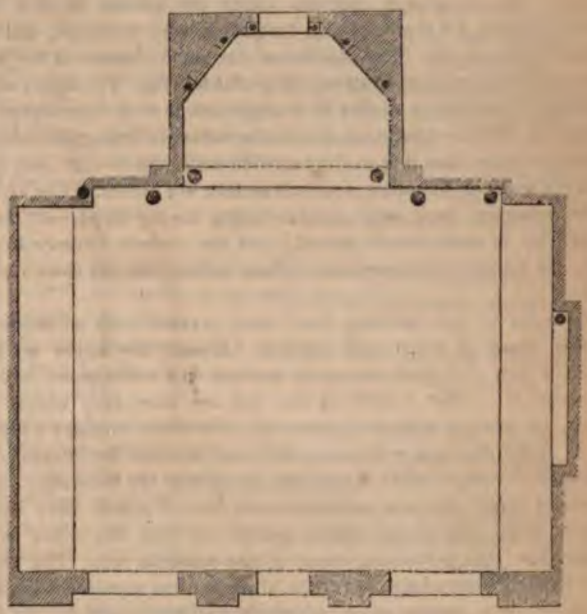
POITIERS, the *Limonum* of the Romans, and present capital of the department of Vienne, is nearly two hundred miles from Paris, on the road to Bordeaux. It is memorable as the field of three of the most important battles recorded in the annals of France; by two of which, at all events, the progress of society was materially affected.[*] The Gauls, the Romans, the Vandals, the Visigoths, the Franks, the Normans, and the English, have alternately held dominion here, and have left their impress on the soil, or in the customs of the people. To the passing traveller, Poitiers, ill-built and mean in appearance, seems hardly to offer sufficient inducement for a stay, giving no evidence at first sight of the many singularly interesting remains of ancient skill which it possesses. It is in all respects an *old* town,—a bye-gone thing,—and takes one back to times when society had not educated itself into so many wants as now, and men cared little for their own habitation, but raised magnificent temples to God. To the antiquary, the architect, the student in history,—in fact to all inquirers,—Poitiers will afford a harvest of information, and be fruitful of suggestions: moreover, being situated on a hill, at the confluence of two rivers, it commands some pretty country, and becomes in itself a picturesque object, when viewed from a distance.

The Gauls have left but one monument in the neighbourhood of Poitiers. It is called there the *pierre levée*, and is considered by archæologists to be either a tomb or a Druidical altar. It is said to be a block of calcareous stone, 22 ft. 3 in. long, 15 ft. wide, and 2 ft. 9 in. in mean thickness. In form it is a lengthened oval, pointing south-east and north-east, raised 3 ft. 4 in. from the ground at one end only, the support at the north-eastern end, if there ever were one, having been removed.[†] It is hardly necessary to remark, that many marvellous stories are told touching the origin of this stone; but with these we may not meddle.

The remains of an amphitheatre at Poitiers, sufficiently large to accommodate more than twenty thousand persons, show clearly the importance of the town in the Roman times. It is supposed to have been built in the third century, and considerably exceeded in size both that of Pompeii and of Nismes. The various ranges of steps, divided by corridors and staircases, are still to be traced, as well as a large arched vault, 18 or 20 feet wide, and 60 or 70 feet long, (formed of rough flat pieces of stone, and mortar, now like a rock,) which inclining rapidly, opens from the outside into the arena, and afforded entrance to the wild beasts, or the little more civilized gladiators.

The most ancient, and at the same time most interesting building in Poitiers is known as the temple of *St. Jean*. The origin and date of this very curious structure have afforded matter for many disquisitions, and have been the cause of much controversy amongst the French antiquaries. Some believe it to have been a Roman temple, others a tomb erected at the end of the third or beginning of the fourth century, in memory of Varenilla, a Roman lady, to whom the city voted a statue and public monument; while a third set of writers, amongst whom is the Abbé Lebœuf, consider that it was, even originally, a Christian church, in the erection of which the materials of some pagan temple were used. From the discovery of an octagon excavation beneath the pavement of the edifice, strengthened by tradition, it is further supposed that it served as a baptistery as well as a chapel. M. de Caumont, who inclines to this opinion, considers the peculiar form of the building is accounted for by its double destination.

Fig. 1.



The accompanying sketch, fig. 1, shows the plan of what is supposed to be the original building, in form a long square, measuring about 30 ft. by 42 ft., with an absis at the north-east end, raised one step above the main apartment, and measuring about 16 ft. by 18 ft. In the opposite wall are three lofty arched entrances, beyond which is a vestibule of more modern, although still ancient, construction, being probably of the eleventh or twelfth century. The floor of the building is several feet below the street level.

Sketch No. 2 represents the general appearance of the north-east end of the building, and although slight, will enable the reader more easily to comprehend the description. The walls, about 45 ft. in height, are divided into two stories, the uppermost of which contains two arched openings, with small columns at the angles, and a triangular-headed space between, and the lower story, the entrance to the absis. The columns in the lower story are of coloured marble, and were evidently brought from some other building, being mostly different from one another in size and

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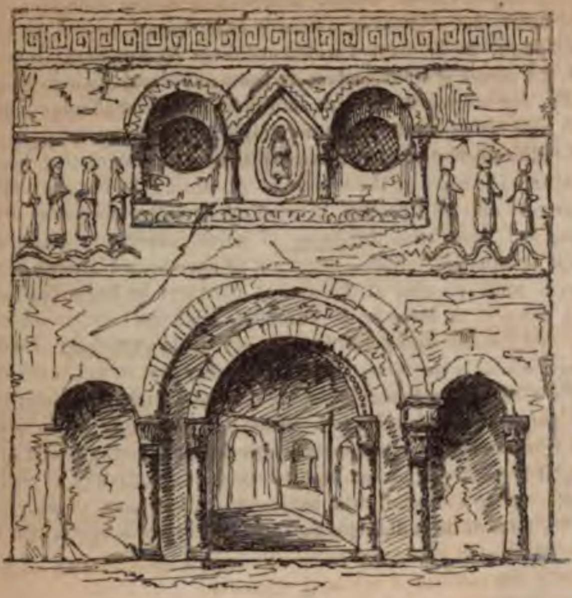
[*] In the sixth century Alaric, king of the Visigoths, was defeated here by Clovis; in the eighth century the Saracens, under Abd-el-rahman, were vanquished by Charles Martel; and in the fourteenth century Edward the Black Prince gained here his great renown.

[†] "Mémoires de la Société des Antiquaires de l'Ouest."

Fig. 2.



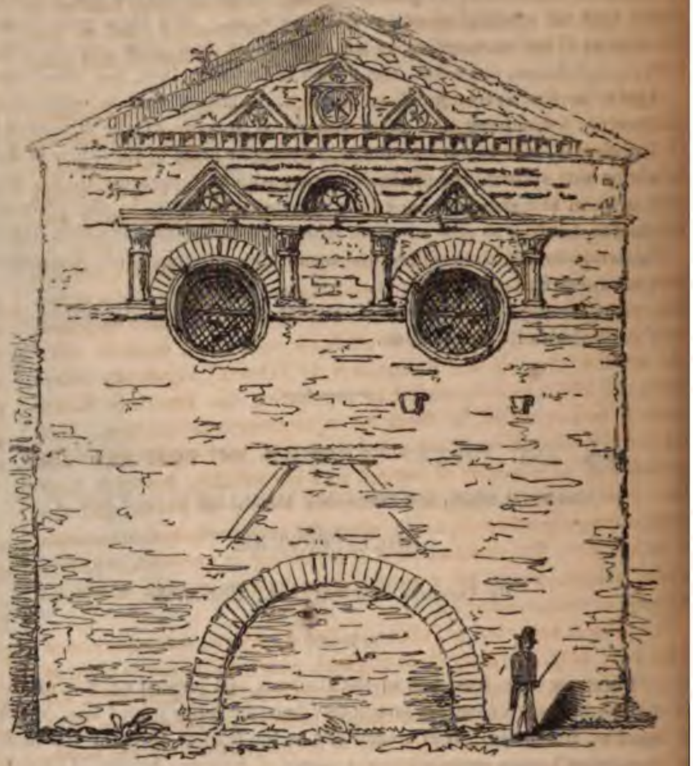
height. The sculptured capitals, which are greatly injured and defaced, indeed, for the most part destroyed, vary in design, and are ill-fitted to the shafts. The capitals of the small columns in the windows are formed of comparatively large flat leaves. The upper story of the two side walls is similar in arrangement to that represented by the sketch, with the exception, that in the latter the triangular-headed opening is wider than it is in the two side walls: in the one case it is about six feet, in the other about three feet six inches. The arches of the windows, (now only circular lights, having apparently been blocked up at some remote period,) and the arched entrance to the absis, are formed of stones about fifteen inches long and three inches wide.

The walls of this building have been covered with paintings or mosaics, many of which still remain. Around the upper part is painted a fret, with birds and other devices on a white panel, in each compartment. The colours in the fret are blue, red, white, and yellow, and have an antique appearance. Over the windows a zigzag line is either drawn in white, or inlaid; and beneath the openings are ornamental scrolls, or other decorations, in colours. On the walls various figures of large size are painted, some few of which have names against them, formed by letters placed one over the other in an upright line: the prevailing colour of the whole is red. The triangular-headed compartment over the absis contains a painted figure of Christ, within a *vescica piscis*, of which mysterious form and its constant recurrence in works of the middle ages, I shall hereafter take occasion to speak.

The soffit of the inner arch leading to the absis is painted; and on the domical ceiling of the absis appears a very large seated figure of Christ or of the Almighty, within a pointed quatre-foil. This has been lately drawn by M. Seguin, for the "Comité Historique des Arts et Monumens," and is described in one of their *Bulletins* to be probably of the thirteenth century: some other figures which surround it appear to be more ancient.

In the absis there is a series of arches and small columns, with capitals closely resembling those of the Corinthian order; one of these is quite so, and the shaft of this displays a slight swell or *entasis*, as is also found in the larger columns at the entrance. Some writers have considered that this portion of the building, like the vestibule, is less ancient than the body of the structure; but this has been warmly combatted, on the ground that the materials composing it and the style employed correspond throughout both. M. Magnon de Lalande is of opinion that the north-west wall, originally similar to that represented by sketch 2, was altered to its present state when the building was converted into a baptistery, and that the absis in question was constructed at this same time, with the materials of the old wall.*

Fig. 3.



The exterior of one side of the ancient part of the building, both being similar, is represented by sketch No. 3. The upper part of the gable, originally inlaid with glazed bricks or coloured marble in patterns, has been rudely repaired, but still displays a portion of its early adornments. The triangular pediments, as well as the square compartment with a triangular head, contain flat rosettes, formed likewise of glazed or encrusted brick. The semicircular opening in the lower arcade presents a small Greek cross, (by accident not represented in the sketch,) and serves almost to identify the original connection of the building with the Christian religion. The series of corbels below the gable originally bore a cornice, now destroyed. Beneath these, ranges of tiles or thin bricks are seen, alternating with the stones composing the remainder of the front. The pilasters, with their capitals and bases, project but slightly from the face of the wall, and, together with the small entablature which they bear, display very rude workmanship.

On first entering this building, or viewing attentively its exterior, one cannot avoid regarding it as a type of those edifices which we term Saxon and Norman; a most interesting link in that chain which connects the stupendous monuments of Egypt, and the glories of Athens, with the cathedrals of Strasburg, Cologne, or York. In most of those architectural remains in England which are acknowledged to be Saxon, as, for example, the towers of Earls Barton church, Northamptonshire, of St. Peter's church, Barton-upon-Humber, and of Barneck church, Northamptonshire, triangular-headed openings, or straight-lined arches if they may be so called, occur; and they are also to

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* "Mémoires de la Société Royale des Antiquaires de France." Tom. xiv. M. Caumont is of opinion there was a similar absis, or small chapel, at the north-west end, before the alteration: this would render the plan of the building cruciform. The same writer is disposed to think the small columns in the windows and the absis are of less ancient workmanship than the larger columns, but that they were worked out of some similar columns, as they are of the same marble. "Cours d'Antiquités." Tom. iv.

elineated on some Saxon MSS., by writers of that period. A
ample of these arches may be seen on the entrance to the old
at Lorsch, between Darmstadt and Heidelberg, attributed
of the eighth century. This pedimental form was often
me for decoration,[*] when architectural skill and knowledge
ning there, as indeed it was greatly at Constantinople. In
f Diocletian, at Rome, columns piled one upon another on
e of window-openings are thus surmounted; and it may
e found on many sarcophagi in the catacombs of that same

in the Saxon buildings of which we have spoken, small
e found swelling in the centre, perhaps a rude remembrance
ssic *entasis;* at other times banded in the centre, and so
sort of baluster. In more than one of them, too, the Greek
rcular panels, or over the heads of windows, forms a pro-
ament.

ple of St. John has experienced many vicissitudes, and has
at different times as a bell-foundry, a kitchen, and a manu-
Standing very much in the way of some proposed improve-
e line of streets, it would have been taken down in 1832,
he "Société des Antiquaires de l'Ouest" vigorously inter-
ultimately succeeded in purchasing the venerable fabric,
ow occupied by them as an architectural museum. Had
y effected no other good than this, they would merit the
of all admirers of ancient art; beyond this, however, they
e much to elucidate the early history of Poitou and the
ing departments, and to induce the preservation of monuments
ty.[†] The destruction of the building in question, which is
ique, would be a most serious loss, as it could never be
r compensated for.

sent cathedral of Poitiers, called *St. Pierre*, was commenced
r 1154, by Henry II. of England, who held Poitou in right of
leanor of Aquitaine,[‡] but was not completed until 1379. Of
al foundation of the cathedral little seems known. In 1018
ure which occupied the site of the present church was burnt,
rebuilt soon afterwards, was again destroyed.

re is a cruciform church, of great width as compared with
divided into three aisles, and presenting in its western
en steps below the street level, three entrance doorways,
ch are a large rose window and two pointed-headed win-
nked on either side by an ugly squat tower. In the mouldings
e door-heads are four series of figures; and in the tympanum
ntre opening are sculptured groups, representing Christ sur-
by angels sitting in judgment, the resurrection of the dead,
eparation of the good from the bad,—the latter being thrown
open mouth of a monster. In the heads of the side doors
sented the death of the Virgin, and St. Peter receiving the
eaven. The whole of this front, with the exception, perhaps,
est story of the towers, is pointed; indeed, very little of the
ular work is anywhere apparent, excepting an attached arcade
e against the north and south walls and in the transepts, and
dows at the east end of the building, the capitals of the
n which latter are exceedingly curious, being formed of the
men in a variety of distorted positions.[§] There is some
ed glass in the church: the easternmost window displays a
Christ within a *vescica piscis*.

The interior of this building, although wide and lofty,[*] has little beauty, and has been much disfigured by modern repairs and additions, —the Antiquaries *de l'Ouest* may here usefully exert their influence, as occasions offer. I cannot avoid mentioning, that the walls of this building both inside and out present on the face of them large numbers of masons' marks, amongst which is the *fish*, and other apparently religious emblems. Several precisely similar marks the writer has found on buildings of much later date in England.[†]

BUNNETT'S PATENT RAILWAY BREAKS, &c.

Mr. Bunnett, of the firm of Messrs. Bunnett and Corpe of Deptford, has taken out a patent for several important improvements, for the better control of railway trains, and the prevention of accidents. They are simple, cheap, and applicable to the present locomotive engines and carriages; and, if adopted, such a perfect command over the train will be obtained, that it may be stopped within so short a distance as effectually to prevent trains coming into collision with each other, or with obstructions of any kind whatever.

The improvements are as follow:—

I.—A powerful engine break acting upon the upper half of the driving wheels, and also simultaneously on the trailing, or the leading-wheels, and occupying the place of, and forming, the wheel-guards.

II.—Self-acting spring-breaks for carriages and tenders, attached to the buffers, and acting on every wheel in the train, partially or altogether retarding it, as the necessity of the case may be.

III.—A very simple and powerful manual break for carriages, &c. This, and the above breaks, are formed of an elastic material, thereby avoiding the disagreeable jar and noise now so generally complained of.

IV.—A simple and efficient mode of increasing the adhesion of the driving-wheels of the engine to the rails, by instantaneously throwing the whole weight upon them.

V.—Spring axle-guides, capable of adjustment, allowing sufficient play in the boxes for the axles to adapt themselves to any curves, or to irregularities of the road.

VI.—A means of communication between the guards and engine-driver, by an alarm bell on the engine, which is struck by a spring lever, acted upon from any carriage in the train.

VII.—A method of shutting off the steam on the instant that the engine-driver takes his hand off the regulating-handle, thereby preventing accidents that might possibly occur from drowsiness, fits, sudden illness, &c.

In illustration of the value of an efficient system of breaks, we need only subjoin a portion of the evidence of no less an authority than Mr. George Stephenson, as given by him before a select committee of the House of Commons.

Question 1317. You have, of course, devoted much attention to the means of preventing accidents upon railways?—A. I have.

Q. 1320. You have paid much attention to the subject of breaks?—A. I have.

Q. 1321. Do you consider them an important element of safety in railway travelling?—A. Certainly; the most important of anything that can be contrived for the safety of railway travelling. I believe, that if self-acting breaks were put upon every carriage, scarcely any accident could take place.

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rlier times, when the principles of the arch were little if at all
d, this form was used constructively, as in the pyramids of Mexico
t; but to this application we need not refer.

Society meets in Poitiers every Thursday during the Session: M. de
the secretary.

was confiscated to Philip Augustus in the reign of King John
me again into the hands of the English in 1360; and ultimately
o France in 1370.

ench writer, speaking of this church, observes, "En étudiant les
epuis celles du chœur construites à la fin du douxième siècle, jusqu'à
portail, qui datent de la fin du trezième, on peut suivre la trans-
Roman au Gothique, qui s'opérait alors, transition bien marquée
me des fenêtres, dans leurs meneaux, dans les cintres et les ogives
orent; ce qui est une nouvelle preuve de l'usage dans lequel on
efois, lors de ces constructions fort longues, de commencer par
t de finir par le portail."—*Poitiers: par M. E. V. Foucart.*

[*] The height of the nave is stated to be 96 feet; that of the side-aisles 80 feet.

[†] To this very curious subject,—the masons' marks of the middle ages,—to which the writer's notice was first given three or four years ago, he has lately directed the attention of the Society of Antiquaries and the Institute of Architects, with the view of obtaining a large collection of the marks for examination and comparison. The "*Comité Historique des Arts et Monumens*" of Paris have recently invited communications on the subject.

BUNNETT'S PATENT RAILWAY CARRIAGE BREAKS, &c.

Fig. 1.

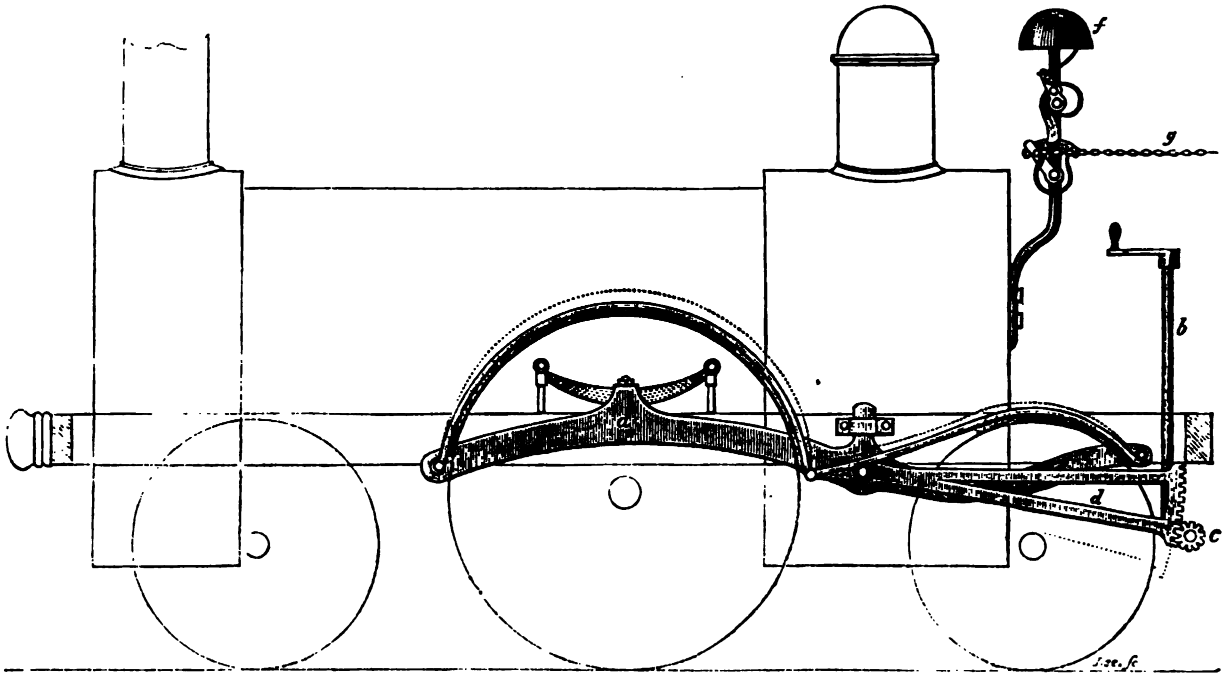


Fig. 2.

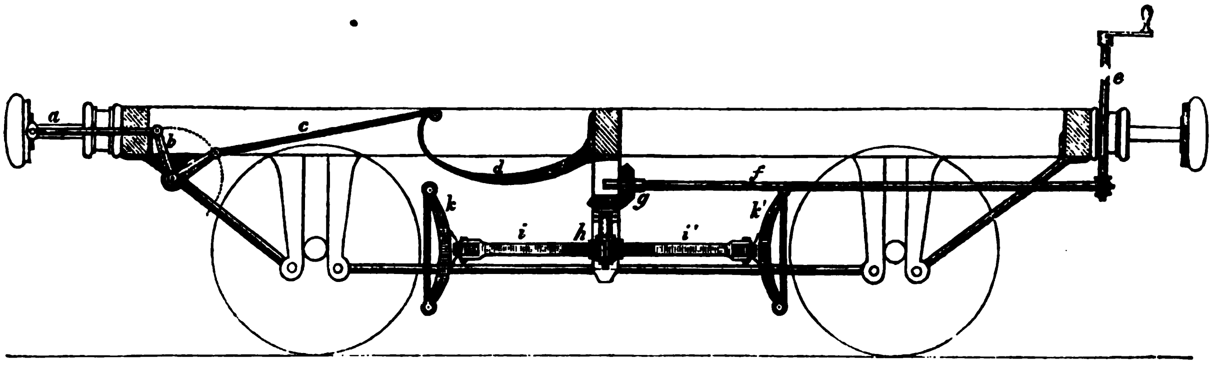
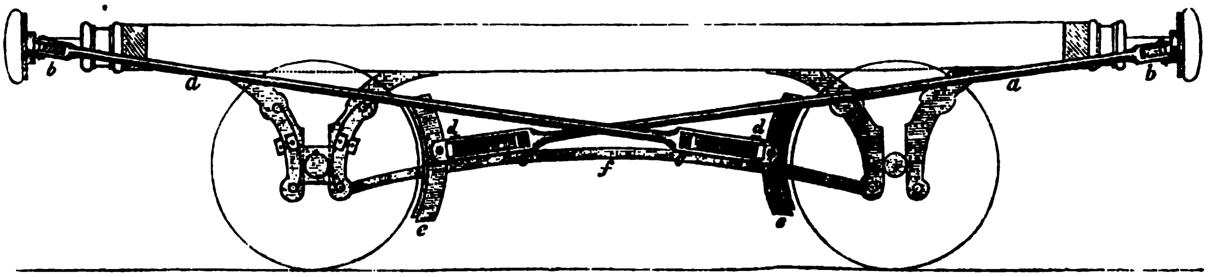


Fig. 3.



Q. 1322. What do you mean by self-acting breaks?—A. Whenever the power is taken off the engine by the engine-driver, it immediately ceases to proceed so fast; all the carriages immediately run towards the engine, with the impetus put into them before the engine was retarded. Every carriage, as it approaches the next carriage, shall apply the breaks itself. Every carriage is brought into the state of a sledge; the rolling motion of the wheels ceases; and supposing that an engine was running on with twelve or fourteen coaches, and that every coach had a breaksman (that is, twelve coaches and twelve breaksmen), and the whole of them upon the look-out to see if anything went wrong in the engine, to apply the breaks immediately, I conceive that the *self-acting principle is fifty times better.*

DESCRIPTION OF DRAWINGS.

Fig. 1 shows a mode of applying breaks to the engine: *a* is a strong iron carriage for the breaks laying flat against the side framings, bearing on and attached to the centre of the springs, and supported also by sliding freely through a plate or staple bolted to the side frame, to allow for the play of the springs; *b* is a vertical shaft, on the bottom of which is a worm, taking into a worm-wheel, keyed on a horizontal shaft, which passes across beneath the foot-plate; on the same shaft are keyed two pinions *c*, working into two racked sectors or levers *d*; on bringing the levers to the position shown, the break-bands are brought down on the tops of the wheels on both sides of the engine; on giving the handle a contrary motion, the break-bands are lifted into the position shown by the dotted lines. Any elastic substance, or wood segments in an iron box, may be bolted to the underside of the break-bands, if thought desirable.

Attached to the fire-box of the engine is a bell *f*, on which, by an arrangement of spring-levers, a sharp blow, or several blows, can be instantaneously struck by the guards from any carriage in the train, a simple and effectual mode of communication with the chain *g* running along the tops of all the carriages.

Fig. 2 is a side elevation of a railway carriage frame. At one end is a *self-acting* break, proposed to be applied to all the wheels; *a* is a connecting-rod attached to the buffers; *b* is a bell-crank, the axis of which is attached to the side frame of the carriage; *c* is a strong belt of leather, plaited hemp and wire rope, or any suitable material, to the underside of which, if necessary, plates of metal may be rivetted; *d* is a curved spring, to the end of which, and to the bell-crank *b*, the belt *c* is fastened; upon the buffer being driven in, the bell-crank *b* is moved in the direction of the dotted line, and the belt *c* is brought down on the periphery of the wheel, with a force proportionate to the strength of the spring *d*, which, on the buffer resuming its position, takes the pressure of the belt *c* off the wheels.

The other end of Fig. 2 shows a *Manual* break: *e* is a vertical shaft, on the bottom of which is a worm, working into a worm-wheel on a horizontal shaft *f*, and giving motion to a pair of bevil-wheels *g*, one of which is attached to a short vertical shaft, carrying a pinion *h*, which takes into two racks *i i'*, kept in gear by friction-rollers at the back; the ends of the racks are prolonged, and attached to the centres of two bars passing across the carriage, and carrying at each end the bows *k k'* fitted with elastic bands, on boxes fitted with segments of wood or otherwise.

Fig. 3 is an elevation of a railway carriage frame, showing another form of *self-acting* break; *a a* are strong iron rods attached to the centres of two cross-bars *b b*, which are fixed at each end to the back of the buffers; the other ends of the rods *a a* are forked, and pass over a spring *c c*, the ends of the springs impinge against bars *d d*, passing across the carriage, on the ends of which are fixed boxes fitted with segments of wood, or with bows, &c. similar to *k k* in Fig. 2; *f* is a curved stay in the plane of action to the centres of the wheels, on which are formed guides for the ends of the bars *d d*; the springs *c c*, and the bars *d d*'', are shown in section; the rods *a a* are capable of adjustment in the length, so as to bring the breaks into action when the buffers shall have been driven in to any point desired; the action of the breaks on all the wheels is simultaneous, and the force equal to the strength of the springs *c c*''.

It will be perceived, that one advantage in these breaks is the absence of concussion on their being applied, as they are governed by the buffers. More or less force is applied, as more or less occasion exists for the same. Should the strength of the buffer springs be at any time insufficient to admit of the backing of a train, there is a ready mode of preventing the action of the breaks upon the wheels.

SLUICE GATES.

Description of the Bear Trap Sluice Gates of the Lehigh Descending Navigation. By Ellwood Morris, *Civil Engineer.*

(From the American Franklin Journal.)

The public are indebted to the inventive genius of Josiah White, Esq., President of the Lehigh Coal and Navigation Company, for the admirable hydrostatic contrivance which has received the singular name of *Bear Trap.*

These sluice gates were devised in the year 1818 by the "*Lehigh Navigation Company,*" for the purpose of improving the Lehigh river by means of wing-dams, &c., so as to form a descending navigation suitable for the transportation of coal from the Anthracite mines, near Mauch Chunk, to the city of Philadelphia.

This work was commenced upon the 10th of August, 1818, and did not originally contemplate the use of sluice gates as a primary expedient; the residents upon the margin of the Lehigh river having pointed out "a certain mark in a rock at the Lausanne landing," as the low-water level of the stream, the Company were induced to believe that there would always be a sufficiency of water for their purposes, if it were "confined by wing-dams in its passage over the ripples, or shoals, from pool to pool," and under this impression the work was begun; but in the autumn of 1818 "the water in the river fell by an unparalleled drought, as was believed, fully twelve inches below the mark which has been mentioned as shown by the inhabitants to be the lowest point to which the river ever sunk. Here was a difficulty totally unanticipated, *and one which required a very essential alteration in the plan.* Nature did not furnish enough water by the regular flow of the river, to keep the channels at the proper depth, owing to the very great fall in the river and the consequent rapidity of its motion. It became necessary to accumulate water *by artificial means,* and to let it off at stated periods, and let the boats pass down with the long wave thus formed, which filled up the channels. This was effected by constructing dams in the neighbourhood of Mauch Chunk, in which were placed sluice gates of a peculiar construction, *invented for the purpose* by Josiah White, one of the managers, by means of which the water could be retained in the pool above, until required for use. When the dam became full, and the water had run over it long enough for the river below the dam to acquire the depth of the ordinary flow of the river, the sluice gates were let down, and the boats, which were lying in the pools above, passed down with the artificial flood."

It was to meet the exigency created by the discovery above-mentioned, that Mr. White contrived the beautiful sluice gate, which we are about to describe, and upon the successful operation of which the whole enterprise very much depended.

At that day the scene of the Company's operations was almost a perfect wilderness, and the carpenters having been set at work to frame a sluice gate for trial, it became an object of great curiosity to the settlers; who being far more familiar with the implements used in the chase and capture of the beasts of the forest, than with the hydraulic works of a flash navigation, either in jest, or from some fancied resemblance of the sluice gate to a *Bear Trap,* quickly gave to it this cognomen, which it ever since has borne.

Fig. 1, Plan.

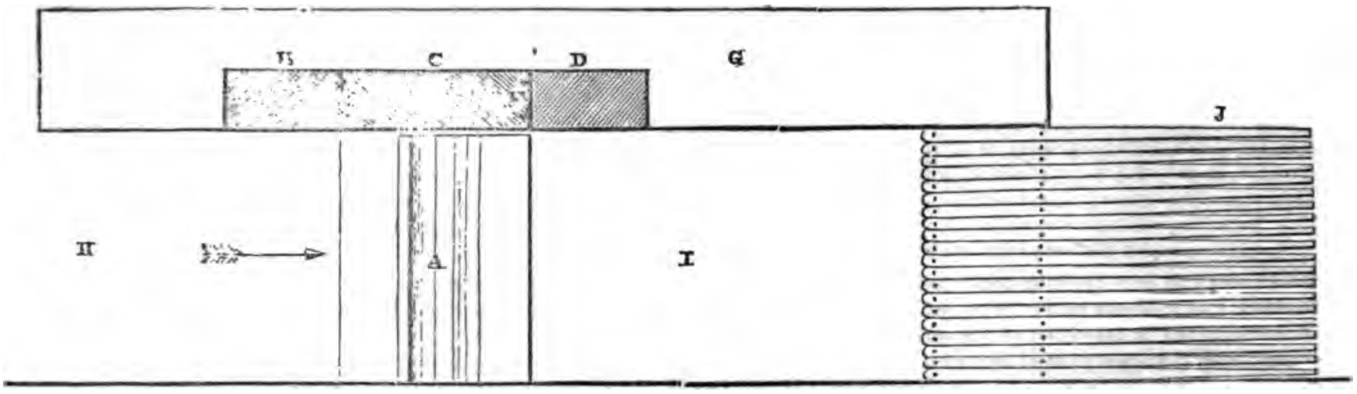
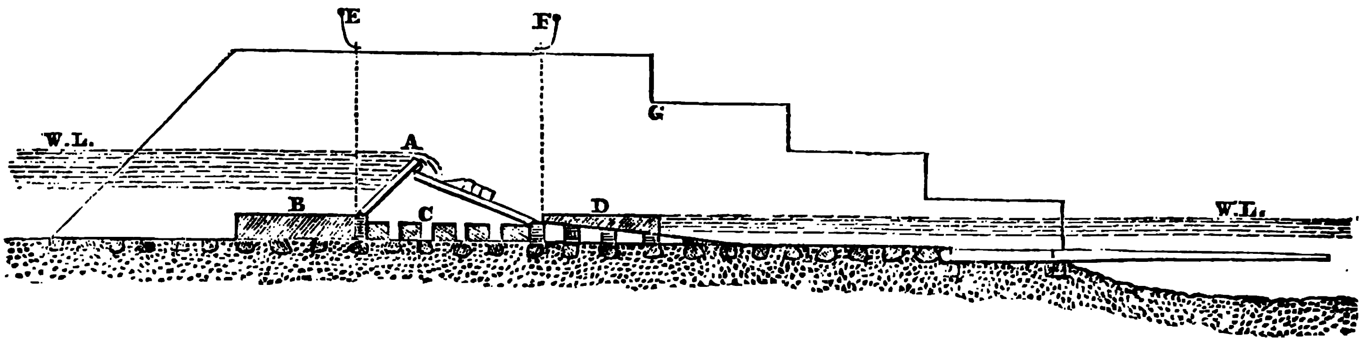


Fig. 2, Section.



References.

A, Upper leaf of sluice. B, C, D, Water chambers. E, F, Wickets. G, Cribwork. H, Pool of dam. I, Plank floor. J, Fingers of timber. W L, Water line.

The *Bear Trap Sluice Gate*, which is exhibited in plan and section in the annexed diagrams, consists of two leaves or shutters, reclining against each other so as to present a triangular vertical section, and contain beneath them a space capable of being filled with water from the superior level, and emptied thereof at will; the contained angle at the vertex, when the gates are up, being rather more than 100°, in order that the leaves may slide easily, one over the other, which they evidently would not do if the vertical angle of the uplifted gate were either a right or an acute angle; this sluice gate is raised and depressed by hydrostatic pressure, applied and removed upon the principle of that well known philosophical instrument called the Hydrostatic Bellows; in its usual form, as applied upon the Lehigh, *it will not work in dead water*, but requires the action of a head more than sufficient to overcome the weight and friction of the gates, to enable it to be manœuvred with facility.*

By an inspection of the diagrams it will be perceived that the leaves of the gate are hinged horizontally with hollow quoin joints, at some distance above the floor: the hinge of the upper leaf being higher than that of the lower, by something more than its thickness, so that even when the gate is down there is a vacant space into which the aperture opens from the well C, because the height of the hinge of the lower leaf is fixed at about the same level as the tops of the openings communicating with the well.

Catch blocks on the under side of the upper leaf A determine the height to which the rise of the gate is limited; the well C is constantly in communication with the vacancy beneath the gate; the water chamber B, is constantly open to the water from the upper level, whilst that of the lower level flows freely into the chamber D; it will be observed that both these chambers communicate by suitable wickets E, F, with the well C; now it will be evident from inspection that if the wickets F, between C and D are shut, whilst the wickets E between C and B are opened, the water from the upper level will enter beneath the leaves with the *upward* hydrostatic pressure due to the head, and the gate will consequently rise. Now, on the other hand, if the wickets E are closed, whilst those at F are opened, the *downward and lateral* hydrostatic pressure of the water in the upper level, acting then upon the top surface A of the upper leaf, will force down the gate; and thus by simply putting the vacancy beneath the leaves of the sluice gate, in communication *separately* with the upper and lower levels *alternately*, the gate is elevated, depressed, or arrested at any stage of its movement, by hydrostatic pressure alone; the only manual labour or attention needed for the highest and widest gates, being that which is requisite to manœuvre the wickets E or F, a duty for which a mere boy would be physically competent.

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* Mr. English, formerly a contractor upon some of the works of the Lehigh navigation, having for many years observed the action of the Bear Trap Sluice Gates, has conceived the idea of rendering them applicable as the upper gates of *Lift Locks*, by placing a large air vessel under the lower leaf, which by its buoyancy enables the gates to rise in dead water: and he has exhibited at the Franklin Institute a working model of a lock having the Bear Trap Gates, with his attached air vessel applied as *upper gates;* and, though liable to some objections, there is reason to believe that for the upper, if not for both, gates of *Lift Locks* only, they will prove to be a valuable improvement, though it is evident that the same object may be attained by the application of counter weights, but not perhaps as well as by an air vessel

The sluice gates used upon the Lehigh descending navigation, as there is no necessity of making them perfectly water-tight, are allowed a play on each side of half an inch or more, which effectually prevents lateral friction; they are generally twenty-four feet wide, formed by spiking together three successive layers of thick plank, and the lower leaf is strengthened by bolting upon its back a few heavy beams, (as may be seen in the sketch annexed,) which rest their extremities against suitable stops when the gate is up.

Where the water, violently descending the sluice, leaves the platform, it usually excavates the bed of the stream and forms deep water, the sudden entrance into which, of boats shooting down the sluice, would prove very injurious to, or even destroy them, if it were not for the ingenious device called *fingers;* these consist of the trunks of trees placed side by side, and bolted to heavy subsills, with their butts up-stream, the tops freely projecting over the lower sill some twenty feet or more; they receive in part the shock of the boat in its plunge into the deep water, and by their elasticity ease off its momentum so that it glides down with the swift stream uninjured. This dexterous mode of avoiding concussion is found in practice fully to answer the end for which it was designed.

For the purpose of guarding the horizontal hinges of the leaves of the sluice gates against obstruction from the deposition of gravel, a glove of plank is ingeniously secured across the hinge by a curved spring; and in contact with this plank glove, the leaf revolves upon its hinges, without the possibility of being impaired in its action by the lodgment of hard substances.

From the above description and the annexed sketches, which are designed more to develope *the principle* of the sluice gate, than to display all the details of its construction, it is hoped that the plan and mode of action of the *Bear Trap Sluice* may be gathered without further explanation, and we will now proceed to make a few remarks upon the great usefulness of this invention.

UTILITY OF THE BEAR TRAP SLUICE.

This skilfully devised hydraulic machine continued in use upon the lower Lehigh—giving perfect satisfaction in practice—from the year 1821 until 1829, when the descending navigation upon the main part of the river was abandoned for an improvement which admitted of transit in both directions: though a section upon the former plan, with its Bear Trap Sluices, still forms the navigation for the lumber trade betwen Whitehaven and Stoddartsville, a distance of 12¼ miles, in which by wing-dams, channels, and sluices, a fall of 336 feet is overcome.

The causes which led to the substitution of a slackwater for a flash navigation, and the difficulties met and surmounted by the ingenious and energetic individuals who directed the works of the Lehigh Company, are so interesting, that we will make a digression to quote a few more passages from the Company's published "History,"[*]

"The boats used upon the Lehigh descending navigation consisted of square boxes, or arks, from 16 to 18 feet wide, and 20 to 25 feet long. At first two of these were joined together by hinges, to allow them to bend up and down in passing the dams and sluices, and as the men became accustomed to the work, and the channels were strengthened and improved as experience dictated, the number of sections in each boat was increased, till at last their whole length reached 180 feet. They were steered with long oars like a raft. Machinery was devised for joining and putting together the planks of which these boats were made, and the hands became so expert that *five men would put one of the sections together and launch it in forty-five minutes.* Boats of this description were used on the Lehigh till the end of the year 1831, when the Delaware division of the Pennsylvania Canal was partially finished. In the last year, 40,966 tons were sent down, which required so many boats to be built, that, if they had all been joined in one length, they would have extended more than *thirteen miles.* These boats made but one trip, and were then broken up in the city, and the planks sold for lumber, the spikes, hinges, and other iron work being returned to Mauch Chunk by land, a distance of eighty miles.

"The great consumption of lumber for the boats very soon made it evident that the coal business could not be carried on, even on a small scale, without a communication by water with the pine forests, about 16 miles above Mauch Chunk, on the upper section of the Lehigh. To obtain this was very difficult. The river in that distance had a fall of about 300 feet, over a very rough, rocky bed, with shores so forbidding, that in only two places above Lausanne had horses been got down to the river. To improve the navigation it became necessary to commence operations at the upper end, and to cart all the tools and provisions by a circuitous and rough road through the wilderness, and then build a boat for each load to be sent down to the place where the hands were at work, by the channels which they had previously prepared. Before these channels were effected, an attempt was made to send down planks singly, from the pine swamps, but they became bruised and broken by the rocks before they reached Mauch Chunk. Single saw-logs were then tried, and men sent down to clear them from the rocks as they became fast. But it frequently happened that when they got near Mauch Chunk, a sudden rise would sweep them off, and they were lost.

"It became evident that the business on the Lehigh could not be extended as fast as the demand for coal increased, while it was necessary to build a new boat for each load of coal; besides the forests were now beginning to feel the waste of timber, (more than 400 acres a year being cut off,) and showed plainly enough that they would soon disappear, in consequence of the increased demand upon them.

"Under all these circumstances, it was concluded that the time had arrived for changing the navigation of the Lehigh into a slackwater navigation. The acting managers, who resided at Mauch Chunk, formed a plan for a steam-boat navigation with locks 130 feet long and 30 feet wide, which would accommodate a steam-boat carrying 150 tons of coal. These locks were of a peculiar construction, adapted to river navigation. The gates operated upon the same principle with the sluice gates in the dams for making artificial freshets, and were raised or let down by the application or removal of a hydrostatic pressure below them. The first mile below Mauch Chunk was arranged for this kind of navigation. *The locks proved to be perfectly effective, and could be filled or emptied, notwithstanding their magnitude, in three minutes, or about half the time of an ordinary lock.*"

One of the writer's objects, in making the above lengthy extract, was to enable the reader to trace the causes which led to the abandonment of the flash navigation on the Lehigh, and to see that it arose from no defect in the sluice gates or other works at first erected.

It must be evident to every one that *the Bear Trap Sluice Gates,* finding as they do their operating power in the hydrostatic pressure consequent upon the difference of level which they overcome, are capable of application to almost any width of opening; and that a gate of 100 feet or more in length could be manœuvred as readily as one of 24 feet, the only additional labour requisite being that of opening and closing a few more wickets.

In the descending navigation of the Lehigh, a case occurred where a fall of 16 feet in about 300 was overcome by one of the Bear Trap Sluices, though it was found necessary here to bolt a series of beams upon the platform, transversely across the opening, so as to moderate the velocity of the descending volume of water, by increasing its friction upon the bottom of the passage.

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[*] In the published history from which we quote, the opinion is advanced, that "the descending navigation by artificial freshets on the Lehigh, is the first on record as a permanent thing."

This, however, is a mistake, for the system of rendering shallow streams —igable by the mode called *Flashing*, which is "to create an artificial flood a time, by penning up the water in the river itself," and then opening the re or flood-gates, when the boats are passing, is supposed to have been ated by the Egyptians after the time of Alexander, and was found in use hydraulic works of the interior of China, when that empire was visited e first English embassy.

[†] New Edinburgh Encyclop., Art. Nav. Inland.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXXV.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. I am not aware that Welby Pugin has been compared to Victor Hugo, but Victor may certainly be compared to Welby, for the one speaks in as depreciating a tone of the productions of modern architecture in France as the other does of those in England. Both are such outrageous admirers of the antique, that is, the Gothic style, that they have no admiration for anything else. In his "Notre Dame" the French writer has commented very freely, though somewhat *à la Smelfungus*, on several of the buildings of Paris, and, among others, on the Pantheon, which he designates a "Savoy cake"! In an article by him in the "*Revue de Deux Mondes*," he has since poured out his vituperation on the Hôtel of the Quai d'Orsay, the Ecole des Beaux Arts, the Chamber of Deputies, the Madeleine,—which it pleases him to describe as "a second edition" of the Bourse,—and the Chapelle Expiatoire, of which he says "rien au monde de plus bossu." "Oh, qui me delivera," he exclaims, "des colonnades!" including under that term porticos also. It is, therefore, to be apprehended, that some of our own classical buildings—those of the Smirke school of design—would not find any favour in his eyes. After all, architectural criticism does not appear to be his forte, for he certainly can understand very little of the style he so energetically reprobates, when he insinuates that there is a strong resemblance of character between the Madeleine and the Bourse;—an opinion pretty much akin to that of the learned traveller who discovered a striking likeness between the temple at Baalbec and Covent Garden Church! There is, however, one expression of his that deserves to be noted, viz. "l'architecture seule, entre tous les arts, n'a plus d'avenir." In this, it is to be feared, there is some truth; and a rather disagreeable truth it is, since the very models that ought to stimulate us to rivalry are converted into obstacles in the way of originality and all effort of our own. Whatever be the style we happen to take up, we make no attempt at carrying it forward, moulding it according to present circumstances.

II. Among some other rather crotchety fancies in the article on "Gothic Architecture" in the last No. of the Quarterly Review, it is asserted that the Grecian style requires that caryatides should be made to express exertion and effort, as if oppressed by the weight of the entablature they support. Now, such figures ought, on the contrary, to manifest perfect repose of attitude, and tranquillity of countenance,—not any sort of effort to bear up against the burthen laid upon them—for that would indicate *weakness*, and their insufficiency for the office imposed upon them, but the ease derived from the more than ordinary power and strength adequate to their office. The mode recommended by the writer in the Quarterly would be at variance with every principle of æsthetics and architectural taste, and also opposed to the practice of the Greeks themselves, who made their caryatide figures to "stand at ease." Some over-sensitive critics protest against the employment of such figures at all, as suggesting painful ideas;—an over-strained refinement of feeling that ought to cause them to be very disagreeably affected by the sight of many other statues, put in situations which would be most perilous for any human being. They who are compassionately distressed at beholding female figures performing the duty of columns, ought to be filled with terror at seeing a statue stuck up on the top of a lofty column, or made to stand as sentry in a niche, exposed to every change of weather—frozen at one time, and fried in the sun at another. There is a good deal of the kind in art, which it is impossible to reconcile with common sense, supposing that mere common sense is to be the judge of it, and that the things which are so shown are intended to be mistaken for realities. How many extravagant absurdities are tolerated in painting! The representations of Cherubim, for instance, are not only absurd, but disgusting; for a child's head cut off, and having a pair of wings tied to it, would be an object which, instead of affecting the heart, would be more likely to turn the stomach.

III. In the "Discours Preliminaire" to the first volume of his "Edifices de Rome Moderne," Letarouilly makes some sensible remarks, one of which is to the effect that those purely numerical relations and proportions, upon which so much stress has frequently been laid, have been greatly over-rated, since architectural beauty is not to be estimated arithmetically. It is, in fact, evident enough that mere mechanical beauty of proportions alone will go but a very little way in satisfying the eye, for those proportions may be observed *à la rigueur*, and the design itself may nevertheless be in abominably bad taste, or, at any rate, dull and insipid. The same writer also opposes the silly notion of the science of music being of any service to the architect. There exists only a certain vague analogy between the two arts; therefore, to fancy that any direct application of the rules of the one can be turned to account for the other, is no better than a chimerical whim, worthy of the philosophers of Laputa. If any such application be possible at all, it ought to hold good one way as well as the other; and the musician might certainly profit just as much by a knowledge of architecture, as the architect can possibly do by studying the laws of musical composition.

IV. In reporting the King of Prussia's visit to the British Museum, the newspapers have not informed us what opinion his Majesty expressed of the architecture of the building, on the plans and model of it being exhibited to him. Perhaps he thought it more advisable to keep his opinion to himself; and he might, moreover, be excused if he felt more astonishment than he expressed;—astonishment at the rigorous economy manifested in that national edifice, compared with the prodigality of the doings at Windsor Castle.

V. About two years ago the newspapers assured us that Prince Albert possessed more than ordinary taste for the fine arts, and that art might accordingly look forward not only to more hearty, but more intelligent patronage than it has hitherto been its fortune to obtain from a British court. Alas! for the sycophantic prophecies of newspapers! The so-boldly-predicted encouragement of art has as yet produced no other fruits than portraits of royal babies, and dog-kennels for royal puppies, except it be the huge royal christening cake—a most unequivocal specimen, no doubt, of superior *taste*. It may be that the predicted patronage is still to come—that we have mistaken the mere buddings and blossomings of it for the fruits. Such, it is to be hoped, is the case, but at all events, the blossoms themselves are of a very sickly kind. For aught that at present appears to the contrary, the future is likely to prove very much like the past, in a country where the sunshine of royal patronage to art has never amounted to more than mere *moonshine*.

VI. If we may believe Toussaint, mathematical science and theory are of comparatively little service in actual construction, and in fact are never trusted to, as architects themselves, he says, very well know, although they do not care to confess as much. "We are aware," he continues, "that such assertion will excite a hue and cry against us from the mathematicians, who will endeavour to prove, by A plus B, that it is *mathematically* false, and that we are altogether mistaken. Yet if we ask them how many architects they can reckon up in Paris who know anything of mathematics, we suspect they would be compelled to reply, in the verse of Boileau,

> "Il y en a jusqu'à trois que je pourrais citer."

and even out of that number, how many are there who have recourse to their mathematics in constructing their buildings? On the other hand, we can oppose to their example that of Messrs. ——, and ——, and ——. But we yield to the force of prejudice and opinion, otherwise we could here produce a rather long list of names of those who will deservedly stand high in the estimate of posterity as celebrated architects, although they are *absolutely ignorant of mathematics!*" If for *Paris* we read *London*, the remark will, perhaps, hold equally good.

SUPPLEMENT AND ADDITIONS TO CHRONOLOGICAL TABLE OF ARCHITECTS WHO DIED IN THE 18TH AND 19TH CENTURIES.

By W. H. Leeds.

Where the precise date of an architect's death could not be ascertained, it is indicated by *ab.* (about). An asterisk * is prefixed to the names of those who have distinguished themselves, not as architects, but as writers on architecture, &c. The names of places in Italics denote that the architect was chiefly employed there.

DIED.	NAME.	BORN.	WORKS.
1742	Naumann, Joh. Chr.		*Dresden*, &c. Author of several publications.
1750	Pitrou, Robert	1684	Inspector of Bridges, &c. "Projets d'Arch. de Charpente," &c.
1753	Haerlemann, Baron	1700	*Stockholm.*
1753	Hartemann		*Sweden.*
1753	Neumann, Balt.	1687	Palace at Brucksal, Würzburg, and Werneck; Abbey at Schwarzach, &c.
1780	Morelli, P.	1730	*Rome.* Palazzo Braschi, Theatre at Imola, &c.
1784	Cooley, Thos.	1740	*Dublin*: Exchange, Four Courts, &c.
1785	*Gioffredo, Mario	1718	*Naples.* "Dell'Architettura," &c.
1785	Garcia, Josef	1760	*Valencia*, &c.
1786	Ivory, Thomas		Blue-coat Hospital, Dublin.
1789	Hiorne, Francis	1741	Sessions House, Warwick; Tetbury Church, &c.
1797	Duran, Ramon	1760	*Madrid*; Pal. Torrepilares, &c.
1799	Harsdoff, Caspar	1739	*Copenhagen.*
1801	Hiernöe, Jens	1748	Architect and Sculptor, *Copenhagen.*
1803	Palmstedt		Exchange, &c. Stockholm.
1804	Fantoni, Pio	1721	Engineering and Hydraulics.
1804	Desprez, Louis J.		Painter and Architect, *Sweden.*
1808	Piermarini, Giuseppe	1736	*Milan.* Pal. Reale; Belgiojoso, Mellerio, Villa Monza.
1810	Platzer, Jos.	1762	
1810	Cassels, Richard		*Dublin*, Waterford House, Kildare ditto, Lying-in Hospital, &c.
1812	*Patte, Pierre	1723	"De l'Archit. Theatrale"; "Etudes d'Archit." &c.
1812	Molinos, Jean		*Paris.* Theatre Feydeau, &c. with Legrand.
1814	Magens, Joh. B.	1748	*Copenhagen.*
1814	*Seroux, d'Agincourt, J. B. L.	1730	"Histoire de l'Art par les Monumens."
1815	Emlyn, Hen.		Repairs St. George's Ch. Windsor. "New Order of Archit."
1816*ab*	Crichton, R.		*Scotland.* Chiefly Gothic style. Bank of Scotland.
1816	Tempelmann		*Sweden.*
1817	Stark, William		Court-house, &c. Glasgow.
1818	Pacassi, Baron von	1758	Hof-architect, Vienna, the Franzens Bridge, Vienna.
1818	Petit-Radel, Louis Fran.	1740	*Paris.* Palais Bourbon, Tresor Royal. "Recueil de Ruines d'Arch."
1819	Stern, Raphael		*Rome.* Braccio Nuovo Mus. Pio Clementino, &c.
1819	Paris, P. Adrien	1747	Façade, Orleans Cathedral, &c.
1819	Viel, Chas. Fran.	1745	*Paris*; Mont de Piété, Hop. Cochin. "Decadence de l'Archit." and other publications.
1819	Pisson, Joh. Bapt.	1763	*Ghent.*
1820	Aikin, Edmund	1780	Wellington Rooms, Liverpool. "Essay on the Doric Order." "Designs for Villas."
1820	Thoroton, Rev. Sir John	1758	Belvoir Castle, additions and improvements.
1820	Hart, Abrah. van der		*Amsterdam.*
1821	Walters, John	1782	Chapel at Stepney, Auction Mart, &c.
1823	Heurtier, Jean	1739	*Paris*; Theatre Italien, &c.
1823	Hurtault, Max. Jos.	1755	Several Hotels at Paris, &c.
1825	Pini, Ermenigildo	1739	Church at Saregno. "Dialoghi sull'Architura."
1825	Jussov, Hen. Christ.	1754	*Cassel*; Palace, &c. *Wilhelmshöhe.*
1829	*Rondelet, Jean		"L'Art de Batir," and other architectural publications.
1829	Harrison, Thomas	1774	County Hall, Chester; Bridge ditto; Theatre and Exchange, Manchester.
1829	Shaw, John		Hall, Christ Church Hospital. St. Dunstan's West.
1831	Peyre, Antoine Marie	1770	*Paris, Ecouen, Altfort*; Villa Trocadero, &c.
1832*ab*	Johnston, Francis		*Dublin*; Post Office, Roy. Hib. Academy, built at his own cost.
1835	Pertsch, John Nepomuk	1780	*Munich*; Prot. Church. Frohnfeste or Prison.
1839	Valadier, Giuseppe	1762	*Rome*; Villa Poniatowski, Tordinona Theatre. Piazza del Popolo, altered. "Edifizi di Roma."
1839	Galbaccio	1800	
1840	Moreau, Charles	1759	*Vienna*: Austrian National Bank.
1840	Huyot, J. Nicol.	1782	Arc de l'Etoile, Paris.
1840	Albertolli, Giocondo	1742	*Milan.*
1840	Gasse, Stefano	1779	*Naples*; Observatory.
1840	Meinecke, Carl Geo.	1756	*Berlin.*
1841	Rickman, Thos.	1777	New Court, St. John's Cambridge; Oulton Church, &c. "Styles of Archit. in England, &c.
1841	Ehrenberg. C. F.		*Zurich.* "Bau-lexicon."
1841	Schinkel, K. F.	1781	*Berlin*; Museum, Theatre, &c. "Entwurfe," &c.
1842	Foulstone, John	1771	*Plymouth*; Hotel and Theatre, Athenæum, &c. "Designs."
*	Aman, Joh.	1765	Hof-architect, Vienna. Theatre at Pesth, &c.

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* We know not if Aman be yet living or not.

CIVIL ARCHITECTURE.

Introductory Lecture on the state and study of Civil Architecture, delivered in the Theatre of the Royal Dublin Society, on the 5th and 8th of January, 1842.

By Henry Fulton, M.D., Author of "Travelling Sketches in Europe and Asia,"—"Collegiate Architecture," &c.

> "From the remains of the works of the ancients the modern arts were revived, and it is by their means that they must be restored a second time. However it may mortify our vanity, we must be forced to allow them our masters; and we may venture to prophecy, that when they shall cease to be studied, arts will no longer flourish, and we shall again relapse into barbarism."—Sir J. Reynolds.

The study of civil architecture is a subject too much neglected. Civil engineering, painting, sculpture, and all the other branches of the arts and sciences receive public attention, while that of architecture is comparatively unaided and unknown. It is not to be expected that Arts' Unions will be established for the purpose of erecting temples and palaces; but I hope to be able to suggest a plan more feasible, and not less efficacious; for it is the privilege of few to erect edifices such as I have mentioned, but it does come within the reach of all to appreciate the beauties of such constructions.

I feel that, as an amateur, some apology is due to you for appearing in this place as a lecturer. The importance of the subject, and its not having been taken up by others better qualified, must excuse me; and I trust that any deficiency, arising from inexperience, may be balanced by the desire of furthering that object.

Should this effort be followed in this city by more scientific labourers, mine may in the interim obtain what astronomers call a heliacal rising, before any light I may be able to throw on the subject shall be lost in the superior attainments of those who may follow.

Feeling that I must leave to others to teach the art, I shall content myself if I succeed in creating in your minds that which so strongly exists in my own,—a desire to become better acquainted with its principles.

It is not difficult to prove that the ancients excelled the moderns in the fine arts of sculpture and painting. With respect to sculpture, witness the Apollo, the Venus de Medici, the Laocoon, and a host of others. As for painting, we have not any of the ancient master-pieces existing in our days; but we have the frescos found in the Baths of Titus, and other places in Rome, and a crowd from Pompeii and Herculaneum: and may we not argue, that as our best painters have not excelled, in drawing at least, the mere decorations of the ancients, how could modern works stand a comparison with those finished pictures, of which the frescos alluded to were probably copies executed by very inferior artists? It is well known that Raffaelle himself took his designs for the Arabesques of the Vatican from those of the Baths of Titus.

The great number of frescos discovered in the places alluded to, forbids the supposition that their execution could have been expensive, such as we read (in Arbuthnot's Tables of Ancient Coins,) of their finished paintings—that a picture of Aristides was bought by King Attalus for 100 talents, *i. e.* about £19,000; that Julius Cæsar gave 80 talents, £15,500, for the Ajax and Medea; and that Apelles was paid nearly £39,000 of our money for his picture of Alexander.

Both painting and sculpture have, in the hands of such men as Buonarrotti, Raffaelle, Canova, and Thorwalsden, made rapid progress to the high goal of perfection attained by the artists of Greece and Rome: but shattered and ruined as the works of Grecian architecture are, enough remains to eclipse the efforts of modern art, whenever a comparison can be made: that is, by comparing things of the same description with one another—the columnar ordinances of the Greeks with those of our own times—the originals with those professing to be derived from them.

We must admit that painting and sculpture have an advantage which architecture has not, in the possession of models and objects of nature, from the study of which a correct taste can be formed; but it is more difficult to lay down fixed rules for the formation of taste, or say what should or should not enter into architectural composition: still we are not altogether left to steer without compass—for if we are to suppose that the first idea of architecture was taken from the erections of the feathered bipeds, then convenience and simplicity, so evident in their erections, should never be lost sight of in ours; and although we may add embellishments to the requisites just mentioned, such ornaments must harmonise with utility and simplicity of design, to constitute, as a whole—BEAUTY: and in all the works of creation, as far as we can understand them, we see that each part has a purpose for which just the requisite degree of strength is bestowed; and the painter or sculptor who would represent the club of Hercules wielded by a Ganymede, the burden of Atlas borne on the shoulders of Apollo, or the muscles of a Vulcan thrown into action to break a fly on the wheel, would be considered as devoid of taste. The same observations apply with force to the laws of proportion in architecture.

Let us now enquire why does not the revival of architecture advance in equal degree with the sister arts of painting and sculpture. It cannot be for lack of *pecuniary* patronage, for some of our architects make enormous fortunes. It cannot be for want of talent and information, for we have many who possess both: for instance, are we to suppose that the architect who delineated the ruins of Magna Græcia, was unable to produce a more correct building than the National Gallery at Charing-cross? No! The cause must be sought for in the ignorance and want of judgment of those who patronise them. Large sums are not given for bad statues or paintings, except by fools or dupes, because men of good taste know something of the value of both the one and the other. Not so in architecture; and the architect, feeling that it is in his power to pass on his ignorant employers any elevation which may look well in a drawing, has not a proper stimulus for exertion; and the science never will flourish, or architects be convinced of the necessity of a closer application to the principles of architecture in its purest era, until those who patronise them learn something of its rules and proportions.

I am not aware that it at all forms part of the acquirements taught at any public school, where so much is learned of the religion of the gods, but nothing whatever of the temples erected in honour of them; and which, as existing monuments, and affording useful models, we ought at least to be as well acquainted with as their worship, manners, or customs.*

Many are deterred from studying the theory of the art, from what they suppose to be the jargon of names which, it may be, convey no meaning to the mind. But let not this difficulty deter: when the thing is known, its name, if forgotten, can easily be found out, and it is not necessary for the amateur to enter minutely into all the details; without which labour, a respectable degree of information can be attained. And the eye which can appreciate the excellence of a statue or a picture, will soon learn to estimate the beauty of a well proportioned edifice; the taste and judgment will call for and be gratified by the reproduction of works of merit, instead of a multiplication of deformity, such as disgraces the national taste, and disfigures the capitals of our country.

In giving a brief sketch, it is not my intention to commence with the fabulous origin of architecture, or to dwell on that of the Etruscans and Egyptians, whose gigantic works, still existing, are objects more for admiration than imitation, more interesting to the antiquary than the architect. But I shall take the subject up when the art had attained its zenith in Greece, in the age of Pericles, when the three columnar orders of Doric, Ionic, and Corinthian existed in a state of perfection, which all subsequent alterations and modifications tended only to degrade and destroy. After the conquest of Greece, the Romans carried off many of the statues and paintings to Rome, which served them as models; but being unable to remove the temples, they could at most carry home sketches, perhaps only mere descriptions of them, and like those of Vitruvius, erroneous ones; hence we have the Doric order with new proportions, and stripped of all ornament, and then called Tuscan, or left with some of them, and with the addition of other parts, and still called Doric. Hence also the shafts of the Ionic and Corinthian columns were attenuated, the capitals altered, and by the combination of the last-mentioned orders, a new one called Composite was formed. None of these alterations appear to be improvements, as we may see by a comparison of the Roman with the Grecian remains: the former indeed may strike the eye of an ignorant observer by its gaudy ornaments, but the latter recommends itself by its noble simplicity and well adjusted proportions.

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* I recollect showing a model to an architect's apprentice, of some two or three years' standing, who did not know a Doric from an Ionic column.

All the buildings now existing in Italy, of a date prior to the subjugation of Greece, are destitute of columns (unless it be the temples at Pœstum, the date of which is unknown, and which were the works of a Grecian colony settled there), nor indeed have we any remains of buildings of a date immediately subsequent to the conquest; but of those which do exist, the buildings of the earlier times, such as the Sybil at Tivoli, the Jupiter Tonans, and the Pantheon at Rome, are more to be admired than those of a later date, such as the Baths of Dioclesian, and the Vesta at Rome, the palace at Spalatro, as also the ruins of Palmyra and Balbec, in Syria, in exact proportion as they exhibit a departure from the Greek models, and to the length of time the practice of the art had passed into other hands.

It must be admitted, however, that the Romans, during this period, invented the arch, and its application—the dome. The Egyptians, from whom the Greeks learned architecture, covered their buildings with a flat roof, of a single stone; and as a roof for the choragic monument at Athens, commonly called the Lanthorn of Demosthenes, we find a single block of marble, nearly 12 feet in diameter, and hollowed out so as to resemble a dome.

The Greeks improved on this monolithic covering, and advanced one step further towards the discovery of the arch, as we see in the corballed roof of the tomb of Agamemnon, at Mycenæ.*

But with the exception of the arch and the dome, the practice of architecture in Roman hands passed on from bad, in the age of Dioclesian, to worse in that of Constantine, when it appears to have lost all its pristine purity. And in the dark ages, when all the arts and sciences may be said to have been lost, architecture lay buried in its own ruins. The only attempt made to revive it in Italy, during this night of ignorance, was by placing the old columns of the Pagan temples in the churches, without reference to their proportions, as we see in the Church of Aracœli, on the Capitoline hill, and that of San Sebastian, outside the walls of Rome.

After this period there arose in Europe a new style, which is generally supposed to owe its origin to our intercourse with the East during the Crusades; a reference, however, to the ruins of Dioclesian's palace at Spalatro, will show the probable origin both of the Saracenic and the Gothic, the offspring of the same parent, the Roman modification of the Greek. And so far from the Gothic being derived from the Saracenic, both are modifications of the same style, taught by the same masters to the inhabitants of different countries, and each of these styles has as much resemblance to the Dioclesian, as this latter has to the Greek. It is true we do not see at Spalatro the clustered column and the pointed arch, but we have slender columns placed on consols, supporting circular arches, and distorted human faces are introduced as ornaments, just as we see them in the florid Gothic. As it was, until within these very few years, contrary to the creed and practice of the Mussulmans to make any representation of the human figure, this practice could not have originated with the Saracens.

Time will not permit our following up this part of the subject, however interesting it may be. We shall therefore leave the Gothic or Pointed style for some other occasion, and pursue that which is called Grecian.

It has been already stated that Grecian architecture, as well as painting and sculpture, were neglected and unknown for centuries, although the world possessed the elements of all three. The works of the ancients were gems, the value of which was not appreciated by the possessors; for the rude figures carved by modern sculptors, before the middle of the 14th century, or the hard, wiry, stiff paintings before the age of Da Vinci, cannot be honoured with the names of sculpture and painting. The revival of both we owe to Italy. That country also lays claim to the resuscitation of Grecian architecture; and a number of her sons, at the head of whom stands Palladio, boast of complete success, although it does not appear that one of them ever saw a single specimen of Grecian architecture, and that their knowledge of it was only derived through the text of Vitruvius, and the Roman debasements, which presented to them beauties they did not profit by—taking only the worst parts of this deteriorated style, which however formed the only beauties of their own compositions.

The estimation in which Vitruvius and Palladio are held in our own country at this day, may be judged of when we hear, *ex cathedrâ*, "that the highest in rank in Italy are not ashamed to be professors of an art which Palladio adorned and Vitruvius taught." To the architects who hold such sentiments I would say—Gentlemen, until you get rid of all such opinions, pure architecture will not flourish, or your profession be placed on that pinnacle of public estimation to which by *birthright* it is entitled.

About the middle of the 16th century, Palladio flourished. Many other architects of equal merit (if indeed he had any), lived before him; but it would be useless to detain you with a mere catalogue of names. Palladio stands confessed as the author of a style, and the founder of a school, still much admired in this country. He has left us drawings of most of the Roman buildings which were in existence in his day, and of course more perfect than they are at present. So far we are his debtors; but strange to say, that although he must have spent much time in measuring the ruins, and designing their restorations, not one of his own designs, except the internal arrangements of a little theatre at Vicenza, appears to harmonise with, or bear any resemblance to the buildings of the ancients.

The chief defects of this school are—

Columns raised on stilts.

Columns placed one above the other.

Columns of different orders ranged in the same elevation.

The two frequent use of engaged columns.

Columns swelling in the middle (offensive to the eye, because an indication of weakness).

Thin columns having wide and irregular interspaces.

Tapering pilasters.

Finishing the tops of doors and windows like the cables of houses, or the roofs of camp bedsteads.

Swelled friezes. And lastly,

All simplicity destroyed by broken lines and partial projections.

I offer no excuse for dwelling on this catalogue of vices, because they have been copied, and are copied every day, in too many instances in our own city. We shall therefore proceed to particularise and notice these errors in detail—that when you see them in your daily peregrinations, you may know them; and when public taste and judgment are better informed on the subject, we may hope they will not continue to be perpetrated.

In speaking without reserve of the modern buildings of this city, I am aware that a door is opened for criticism on the opinions advanced. Well: let it come! However the controversy may terminate, it must lead to the elucidation of a favourite subject. I freely admit that they who have designed those buildings have what is esteemed high authority for what they have done; and if they have not done better, it is because public taste (ill informed as it is) sought for no improvement.

I feel that it would be unworthy both of you and myself, were I to stoop to conquer by flattery the displeasure of any, in setting before you all a stimulus for exertion in the acquirement of architectural knowledge.

Most of the errors I have mentioned may be found in the Palace of

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* I here beg to correct an error made in the Travelling Sketches, vol. ii. 209, where the choragic monument is mentioned, instead of the tomb of gamemnon.

Dioclesian at Spalatro. That emperor, like our own George IV., was a patron of the arts, and immense sums were lavished both at Rome and Spalatro, at London and Brighton; but architecture is not much indebted to the florid taste of either.

The innovations of Dioclesian's time are so striking as to merit his name being given to the style; and as the term Gothic was applied by Sir C. Wren and others to the pointed style, may we not call the Palladian modification of the Dioclesian by the name of Vandal.

The term Gothic, as a name of contempt, is now felt not to be deserved by the beautiful pointed style, which although charged with meretricious ornament without limit, regardless of all order, trifling and weak in detail, is yet magnificent and beautiful in the aggregate.

The Vandal is chargeable with all the defects, which are not redeemed by any of the beauties of the Gothic. But to proceed with the list.

Columns on stilts.—These may be seen at Spalatro, though not in the same perfection as on the front of Trinity College, or the continuous stilt or too lofty stylobate of the College of Surgeons in Stephen's-green. We also find it in the portico of a temple in Umbria, which Palladio says was the only instance of the kind he had seen. He seems, however, to have been enamoured with the invention, for it enters largely into many of its structures. At best it is a shabby expedient to save the expense of larger columns, which would be required to give the height of these smaller ones and their stilts. I ask, what is the use of columns in any case, unless it be for effect? And if that be the object, is it not defeated by placing them above the range of vision? Wherever the columnar ordinance is used, columns must be principals; and is it proper to place principals above the range of the eye.

Columns placed one above the other.—We have no very striking example ofthis in Dublin; but we find it in the west front of St. Paul's and many other buildings in London; and Palladio says the Tuscan should be placed underneath, then the Doric, then the Ionic, then the Corinthian, and lastly, the Composite order—rules fit for the erection of a tower of Babel. It must be granted that columns should harmonize in apparent solidity with the weight of the superincumbent cornice which they are to support. This effect will be destroyed, if one or two other rows of columns and accessories are to be placed above. The Greeks used the expedient to a certain extent, as in the example before you; but only as a choice of evils—for if the internal columns of the cella had been large enough to reach the inclined roof, they would not have harmonized with the other columns which they were to be viewed in connection with; besides, they are of the same order, and were placed almost out of view.

Columns of different orders ranged in the same elevation.—A design never can be chaste, if it contain more than one order; and in this respect, the west front of the Bank of Ireland, the old Parliament House, is disfigured by the Ionic semi-columns in juxta-position with the Roman Corinthian portico. The Bank is like a man wearing a coat with one sleeve of a different colour, both from the other and the body of the garment—a fashion not yet adopted in dress. This Corinthian portico wants the elevation of a basement, and by giving it that, it would be made to overtop the body of the edifice. I understand that originally it had a basement, before the street was filled up to its present level. In short, this deficiency is to be objected to almost as much as the other extreme of having a too lofty stylobate; and so sensible was the architect who erected it, of the injury it sustained in being shorn of its fair proportions, that he never could bear to pass through Westmoreland-street, after the operations of the Commissioners of Paving.

Did time and place permit, the history of this portico would be as instructive as the account given by an Irish historian, called Swift, or some such name, of the violent contest between two powerful nations, as to which end of the egg should be broken. Suffice it to say, that our domestic struggle for prerogative coeval with that for the Bill of Rights, terminated by the belligerents, the Lords and Commons, selecting different orders of architecture for their respective entrances to the same edifice—thus agreeing to differ, and furnishing most convincing arguments, which may be used (according to an ordinary formula of our profession,) *pro re nata*, for or against a repeal of the legislative union.

It has been said that the Greeks, particularly with the Doric order, placed columns without any base. They did no such thing; you will see, in the example before you, that the steps form an ample basement. What would the finest statue that ever was made appear to be, with its feet sunk in the ground or cut off? The eye of criticism, and we are all critics in our way, dwells rather on defects than beauties; and one blemish more than counterbalances twenty excellencies.

Engaged columns.—The too frequent use of this expedient is to be condemned. The effect of columns in a composition arises not only from their graceful forms and well adjusted proportions, but from the lights and shadows which play around them—the chiaro-oscuro of architectural composition; and this effect cannot be obtained by engaged columns. Instances of this may be seen in the front of Trinity College, and the College of Surgeons in Stephen's-green. In the example before you, (the Maison Carrée) may be compared the engaged and disengaged columns. We are not, however, to take the engaged columns of the Bank of Ireland as the design of its architect, for they originally formed an open piazza; but for some wise reason, or perhaps for no reason, they were subsequently built up as we find them at present.

But if we must have attached or engaged columns, I would suggest that they should not be diminished at all, but carry the same diameter from base to top. I never heard of any example of this—but on looking at any of the Palladian Arches, as for instance, those in the principal front of the Bank of Ireland, you will find that the back ground (if I may so speak) to which the columns are affixed, appears like an inverted pyramid, a figure which cannot have a pleasing effect. This is not the case when the columns are detached, on account of the depth of the shadow.

Interspaces of columns.—In the Doric order, the rule is clear and well defined—one triglyph over the centre of each column, and another over the centre of each interspace. The spaces between these triglyphs, called metopes, must be a square, the length of whose sides is regulated by the diameter of the column at its base. These triglyphs are supposed to represent the ends of the beams intended to form the ceiling, and if too many of them be introduced, the architrave on which they rest would be too weak, or what is the same thing, appear to be too weak, to support the weight. I admit that there is an additional triglyph introduced in the propylea on the Acropolis; but it ought to be considered as forming the exception—not the rule; and appears to have been for the purpose of leaving a wider space for the entrance of processions. Another instance occurs in the Doric Portico of Augustus, but it is of Roman construction. This innovation has been extended by Palladio and his modern followers; and we find, in some instances, six or more introduced, and in situations where they are not at all requisite; for instance, on the cornices of windows or door-ways. Why should beams be placed there, or in the inside of buildings, as we see in the chapel in Marlborough-street? I am not aware of any ancient example of this. The east portico of the chapel just alluded to shows a great poverty of conception in the architect, who has placed an additional triglyph between each column—indicating either that the columns are too thin, the interspaces too wide, or the frieze too low. At least a hundred instances of this bad taste occur in the public and private edifices of this city, and scarcely an example of the contrary. But compare the portico in Marlborough Street, notwithstanding its defects, with the Vandal Doric one in the College Park, the design, I believe, of Sir William Chambers, and you will perceive its superiority.

Tapering pilasters.—This extraordinary practice is of the Vandal school. As the situation of these square columns or pilasters is at the angles of the building, they cannot of course square with the wall unless it were made pyramidal also — the absurdity of which is obvious.

You will find this in every building in Dublin where they are used, except those of a late date—a departure from the Vandal school to be hailed with satisfaction. The Greeks never tapered their square columns or pilasters; nor did the Romans, in some of their best erections, as for instance, the portico of the Pantheon. I beg to call the attention of the profession to this, as I have heard a contrary opinion expressed in this country. You will find the pilasters of the portico in Upper Gardiner Street partially tapered; which is surprising, as a Greek model appears to have been taken for the Ionic capitals of its columns. In the same example may be seen the poverty of a four columned portico, as the tympanum of such a structure must necessarily appear heavy, and have too high and abrupt a pitch. Still it is in better taste than the unfinished and much admired Vandal portico of St. Thomas's church. It has been considered by many, that the circumstance of this latter portico being allowed to remain unfinished is discreditable to the parish; but the reverse of this conclusion is nearer the truth, as far as architectural taste is concerned.

Gable-topped windows and doors.—Of all the strange devices of which I have given a list, this is the most strange. The earliest example of this practice with which I am acquainted, is to be found in the Pantheon at Rome, the most recent in our own city; of late it has been discontinued in London, but still finds admirers in Dublin. I do not know whether we are indebted to an architect for this, but I presume not. And here I may allude to the practice of taking builders out of their proper sphere, and allowing them to supercede the architect. This is as foolish as it would be (could we suppose it possible,) that one whose personal tabernacle required repair, should have recourse to the manipulator of medicines, instead of the well informed professor of the healing art. But I must add, if the art is to be *taught* from the dogmas of Vitruvius, and *adorned* from the designs of Palladio, it matters not to us on whose shoulders the mantle of patronage may fall, on that of A. or B., the architect or builder. After all, it may be my misfortune not to be able to appreciate the beauty of the building in question; no doubt posterity will do it justice, for it will come under their notice as the property of the President of the Royal Institute of the Architects of Ireland.

The profession of architecture in this country is placed in a false position—pressed on the one hand by that of aspirant builders, and neglected on the other by a *discerning public*, which is not only unable to decide on their respective merits, but is also ignorant of those principles on which alone good taste is founded. Under these circumstances, it is not surprising that every edifice assuming an architectural form, is praised or reviled according to the number and influence of the friends of the architect. Committees and individuals requiring architectural plans, decide on the relative merits of designs submitted for their inspection, more from the beauty of the drawing, than any reference to the effect likely to be produced in stone and mortar: hence he who is the best draughtsman will be the most fortunate competitor; and the work may be executed without producing credit to himself, or satisfaction to his employers. This state of things could not exist, if public taste were better informed.

The Pantheon was first used as a church by Pope Boniface IV., at the commencement of the 7th century; but the state of the arts in those days forbids us to suppose the altars had not been erected before that period; they are supposed to have been added by Septimus Severus. Almost all the Vandal school have left specimens of this innovation. Palladio, M. Angelo, Inigo Jones, Sir C. Wren, Sir Wm. Chambers, and many others of our own times, who seem to follow, for no better reason than because others have led the way. Some of these architects, conceiving, I presume, that variety is pleasing, give us a gable-topped and an elliptic bed-topped window alternately.

When I see a well proportioned window or door thus disfigured, I am forcibly reminded of the story of the worthy country squire, who hired a strolling artist to paint wigs on the heads of Vandyke's portraits of his ancestors. I was unable to discover the use of these window tops until I saw, on the front of one of Palladio's palaces in Italy, two undraped colossal figures, reclining in a perilous posture above each window, literally in a *tête-à-tête* position, like slack-rope dancers resting themselves. Would it not be in better taste to consider these window-tops as hobby-horses, and place a saddle and a rider on the summit of each, in a more secure position.

Swelled Friezes.—This invention bears a close resemblance to an article of dress said to have been used by our great grandmothers, called a *bustle*; and if it be true that these ancient dames wore any such ornament, no doubt the hint was taken from them.

I cannot discover that the ladies of old ever placed the bustle on the front elevation, as we see it in the Bank of Ireland; nor can I from memory say whether the old lady in Threadneedle-street has it or not. If the frieze were constructed of any plastic material, such as wet clay, this is exactly the form it would take on being subject to pressure from above; therefore it indicates weakness. As bustles have long since gone out of fashion, we may hope the swelled frieze will follow. On examining the Bank of Ireland, you will find it discontinued on the east, and afterwards on the west front, for which the architect of that portion of the building deserves great credit.

The last subject of the list is—

Broken lines and partial projections.—A knowledge of painting and sculpture is among the many requisites laid down by Vitruvius, as necessary to constitute an accomplished architect. But architecture has suffered in the hands of the professors of the sister arts; and M. Angelo, Buonarrotti, and Raffaelle have tarnished their bright fame by their architectural productions. Inigo Jones left England as a painter, and returned as an architect.

The finest field that ever was opened for the genius of man, presented itself to M. Angelo. He enjoyed the patronage of Leo X., a prince born of a race of patrons of the arts. Rome presented to him a vast quarry of marble, ready chiselled; he was required to erect on the Capitoline a building for a senate-house and museum, near the site of the Temple of Jupiter, which once crowned the mount "the pride of Rome, the admiration of the world." Before him lay the ruins of the Forum Romanum, and on his left that of Trajan; to the right and behind he had ruins of temples, triumphal arches, and columns in abundance: he began by turning his back on the Roman Forum and all the beauties of art which it presented to him, and constructed three sides of a square, mean, trifling, and frivolous in design, presenting specimens of nearly all the monstrosities of the Vandal style. He has adorned Rome after the manner of Palladio, his cotemporary; but his works stand no comparison with the still existing monuments of past glory: and the descendants (if such there be) of the Scipios, the Ciceros, and of him who was "the noblest Roman of them all," although the possession of St. Peter's may flatter their vanity, yet sigh as they pass on—*ma Roma, Roma, non e piu com era prima.*

It must be admitted that M. Angelo's lofty dome on St. Peter's, and the cornice on the Faranese Palace, redeem his name from indiscriminate censure. It was part of his plan to make St. Peter's a Greek instead of a Latin cross, and to give it a portico like the Pantheon. As it is, the exterior of the dome cannot be seen from ordinary situations; and in taking the design before you, the painter must have been on the top of one of the houses between the church and the Tiber.

Canova, too, the bright star of modern sculpture, into whose works the spirit of the Apollo, the Venus, the Laocoon is instilled, has left us a design for a church, sufficient to show that he studied not the architecture as he did the sculpture of ancient Greece.

In fact, painters cannot well be good architects, as far as the Greek style is concerned. Accustomed to feel that "there is no beauty in straight lines," they break up the building for the purpose of giving pictorial effect to the design, and "however contradictory it may be in geometry, it is true in taste, that many little things will not make a great one." An architectural drawing of a Greek subject is a stiff, formal production, totally different from Hogarth's line of beauty. Models are the fittest representations for the public to judge from. Take this temple and break up all its cornices; place its columns in any line but a straight one, and the painter will prefer it for a subject; but if in that state it be raised in stone, its beauty will be lost, because its simplicity will be destroyed. According to Burke, simplicity is a source of beauty—it is essential to that of Grecian architecture.

The Parthenon, and the temple of Neptune at Pœstum, are now stripped of ornament, yet they make up by simplicity and unity of design, for the want of it, except in the estimation of those architects who conceive that they are defective in not having steeples!

We may not be going too far in saying, that the Parthenon is the best, and the temples at Pœstum the earliest examples of the Doric order. The former was erected nearly 500 years before our era, in the best days of Grecian art. Of the date of the latter we know nothing, except that a colony from Greece settled in Calabria, and founded the city of Posidonia, before Rome was built: even if we did not know this, they bear the impress of Grecian mind, and reject the hand of any other master.

It is the practice of modern times to take a Greek or a Roman portico, and place it in front of a windowed, corniced, and balustraded building like our Post Office (Dublin). By this expedient, unity of design is destroyed; and however correct or beautiful the portico may be in itself, it will not appear to the same advantage as if its cornice squared with the sides of the building. When this arrangement may be incompatible with the required purpose, it is much better to dispense with the columnar ordinance altogether, and have recourse to some of the other styles. I am rejoiced to find that a new system has lately been introduced into England, of erecting plain, symmetrical structures, surmounted with a handsome unbroken cornice, such as that of the Faranese Palace at Rome. In some remarks which I published on architecture, I pointed out the advantages of this style, before I was aware that its introduction was in contemplation.* The nearest approach we have to this style in Dublin is the Royal Hibernian Academy. The unbroken line of the cornice at the top of the building has a good effect. It will stand a comparison with the Palladian one on the newly fronted edifice in Merrion-square; and the recessed portico is much better than one placed up against the main structure would have been. There are however some great defects in this building: the Vandal headed windows, resting on little bustles; the Doric columns of the portico are too slender, being about seven diameters high, which is two more than they ought to have been under such a superstructure. The angles of the walls, next the columns, should have had pilasters or antis. The balustrade at the top of the building is in bad taste. Balusters are deformed dwarfish columns of the Vandal, and are not in good keeping with columns of the Greek school, no more than a pigmy would be a suitable quiver-bearer for the Pythian Apollo; besides, a cornice is the proper finish for an architectural structure. The arrangement of the windows also is bad, not corresponding at all with the opening of the recessed portico.

One cannot view our Custom House (Dublin) without feeling that all simplicity was sacrificed in its construction, according to the false taste of that period. If the cornice had not been so much broken up, and there had been no balustrade or attic above it, the effect would have been good: as it is, the building can only strike us for its magnitude, the good quality of the stone, and the fine situation it enjoys. It must be admitted that when viewed from such a distance that its faulty details cannot be observed, the effect is fine, and just such as it would have been from every point of view, had Greek simplicity guided the architect in its design.

What is it that rivets the eye on the Irish Round Towers? It is not any historical association, for the history of our country does not speak of them: neither are they Vitruvian nor Palladian; they are better—simple, graceful, and beautiful; and therein lies their attraction. May I be permitted to speak on behalf of that of Glendalough, which, for want of a little restoration, bids fair to be in ruins ere it be recorded in the long expected work on Round Towers, from the pen and pencil of Mr. Petrie. Surely his Grace the Archbishop of Dublin, who is lord of the soil, cannot be aware of its delapidation.

The same observations apply to the Egyptian obelisk, commonly called Cleopatra's Needle, of which there are so many in modern Rome. The best imitation of this, with which I am acquainted, is to be found in the Primate's demesne at Armagh; and although it is not to be compared in magnitude to the Wellington Testimonial in the Phœnix Park, and did not perhaps cost one tenth of the sum paid for the erection of that trophy, yet far excels in beauty of proportion; showing us that mere masses of material, unless arranged with taste, fail to produce satisfaction, whatever name may be given for the purpose of rendering them imposing.

The combination of parts of different orders in the same building is to be avoided, for although the association of Goths and Vandals, as the destroyers of the remains of ancient art in the south of Europe, be strong in our minds, yet the union of the Gothic and Vandal styles cannot be recommended. A striking example of this occurs in the Duomo at Milan; it has Vandal windows and doors, although all the other parts of the edifice are florid Gothic.

The Greeks never surcharged their buildings with ornaments; yet both they, and after them the Romans, devoted the greatest care to the composition and finish of works never intended to come in close contact with the sight. I have been perfectly astonished at the beauty of the mouldings and capitals, when strewed on the ground amidst rubbish and ruins. Together with a deviation from the Greek models, a desire for multiplicity of ornament and novelty was introduced; and long ere the fall of the Roman empire, luxury and refinement, which sapped their power in the government of the world, tended also to the decline of architecture. May we not express a hope that a recurrence of the same principles may not produce the same effect in our own times and country.

The Elgin marbles in the British Museum, which challenge a comparison with the best works of antiquity in the possession of other countries, were, for the most part, placed on the tympanum of the Parthenon, upwards of 50 feet above the level of the eye. The column of Trajan is 132 feet high. These casts were taken for me by a man who was suspended from the top in a basket; you may judge of the finish of the marble by the casts, after the original had been exposed to the weather during so many centuries.

I have now endeavoured to set before you some of the prevailing errors of modern architecture, and some of the beauties of the ancient. In advocating a closer acquaintance with the latter, I may quote the words of an eminent painter, who observes, "From the remains of the works of the ancients the modern arts were revived, and it is by their means that they must be restored a second time. However it may mortify our vanity, we must be forced to allow them our masters; and we may venture to prophesy, that when they shall cease to be studied, arts will no longer flourish, and we shall again relapse into barbarism."

ON ARCHITECTURAL PRECEDENT.

SIR—Permit me, through the medium of your journal, to make a few observations on your correspondent H. S.'s remarks on "Architectural Precedent," which appeared in your journal for January last. I think it is but right, before we condemn *in toto* the use of precedent, to inquire a little into its origin.

Precedent I conceive to be coeval with architecture, and that of architecture with the necessary wants of man; and as age after age became more refined, so the wants, and necessarily the architecture. It would be impossible to find a nation throughout the world, at any period of its existence, whose architecture did not progress in an equal ratio with its refinement, but throughout never changed its character. The first laws being laid down, the architects invariably followed them: and why? because they were made to suit the wants of the nation, both as regards climate and economy. Indeed to such an extent has this been carried, that were it not for the remains of architectural elegance scattered up and down that part of the once refined world, what would there now remain to tell of the highly polished Athens, or of the internal comfort and domestic economy of the ancient inhabitants of Pompeii and Herculaneum? Your correspondent, in his desire to do away with precedent, starts out with condemning the course of study pursued in an architect's office. Now I should rather say, the fault (if it be one,) does not commence here, but in the very first dawn of the pupil's infant mind, because it is the most natural course of events, and necessarily so, that seeing one kind of architecture, the mind gets imbued and impressed with a love, and I might almost say with a veneration for it. To produce an entire change in architecture, which appears to be the wish and aim of your correspondent, it would be necessary that the inventor, if I may be allowed the term, should be brought up in utter ignorance of our present style, and almost destitute of any knowledge of our domestic economy; and then it cannot be expected that he should bring the same to perfection, as it is the natural course of Providence that all things shall progress, "necessity" being made the "first law of nature."

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* Travelling Sketches in Various Countries, vol. ii, p. 206.

Precedent, I think, must appear to every person to be necessary to the right discharge of almost every duty of our lives. It must actuate all; and indeed so mixed up is it in every grade of society, that it does actuate all our movements. It has done so from Adam's fall, and must continue to do so to the end of time.

Your correspondent next repudiates the idea of adhering to one period of architecture in forming a design, and inquires, why should not an ornament of a late period be introduced in a design of a much earlier, provided the same looks well? And forsooth, why not? why not unite the chirolt mould of the Norman to the compressed arch of the Tudor, and the mongrel column of the late degenerate Elizabethan school? Perhaps your correspondent would affirm that this would not look well; and truly it would not to a correct eye, but to a pupil brought up according to your correspondent's wishes, such a *conglomeration* would not appear incongruous, neither would he understand why it should not be so. Should such a state of architecture ever arrive, when an architect could with impunity amalgamate different periods, and I might add different styles, for the evil when once let in would not stop,—should such a time ever arrive, architecture will then be on the wane, England's glory will be setting; for, to go back to precedent, there has never been a country whose architecture has degenerated, but whose whole energies have been crippled, and whose glory has set. While at the same time I would give to precedent its place, I would not be unmindful of the great use of it. I conceive it to be the curb of the architect's imagination; not that he is servilely to follow all its dictates, but to guide his judgment, and having studied fully all its bearings in ancient architecture, he will be better able to come to a correct notion of what true architecture ought to combine, and will act rightly, having had his mind thus well schooled. This I conceive to be the great use of precedent, not only in architecture, but in every other study.

Having thus inquired into the great use of precedent, allow me now to inquire into the right use of it. To make a right use of precedent, it requires a thorough knowledge of ancient architecture, and not of architecture only, but also the domestic habits and economy of former ages. To do this, it is impossible that any man can gain it by the "road side,"—it unfortunately is not written so clear, that he that runneth may read. What then is required? much more than, I am sorry to say, the Royal Institute of Architects imagines, or I cannot believe that men in the highest ranks and ability in the profession would ever remain so supine to the best interests of their profession. Why is it that that body does not bestir itself, for now is the time, while they have such interest, their President being the representative of royalty in the sister land? Why not obtain for architecture what the Royal College of Physicians and Surgeons have done for medicine? Then, and not till then, will architecture and architects take their proper stand throughout the country. What can militate against architecture so much as the fact which is a very common occurrence in the country, of a common *joiner*, with a little more *nous* than his brethren, practising as an architect, to the great detriment of the legitimate architect? And that man gets supported: why? because he undertakes work at a much lower charge than the other; and merchants, who only look at the pounds, shillings, and pence, are well satisfied, although there is the greatest incongruity, such as I have seen. Amongst numberless others, to mention a small thing, of putting the Tudor rose in the facia of a Grecian shop façade, and otherwise mutilating the style. Of course this, to your correspondent, would not be any detriment or eye-sore, as *it looks well* to a man who knows no better.

I am, Sir,
Your obedient servant,
J. M.

Sheffield,
Jan. 26, 1842.

ARCHITECTURAL PRECEDENT.

I WAS agreeably surprised upon finding two correspondents expressing ideas so nearly coincident with my own on this subject, when I had rather expected that, if any notice was taken of the matter, it would emanate from the adverse party, and convey anything rather than approval. It would be well for architecture, if a larger proportion of its professors held the same liberal views as those espoused by "Ditto" and "J. L."

The remarks of the former so entirely agree with my own notions on the subject, that they do not call for any reply: J. L., however, in consequence of the want of explanation, has not taken that view of the influence of classical education which I had intended to convey. Its general effect upon the public mind—the bias which it produces in the feelings of society—the erroneous impressions it gives rise to—were the results to which it was wished to draw attention.

It will, I think, be at once conceded, that if one subject be allowed to engross any mind, to the exclusion of all others, that subject will be almost certainly magnified in importance far beyond its proper standard, even though that mind may be well informed in other departments. How much more, then, will this be the case, when the attention has been confined to one study during the whole course of education, when all other kinds of information have been withheld, and when there has been no opportunity of drawing any comparison between the merits of different branches of knowledge, or different races of men? Is it not probable, therefore, that when a young man has spent all the early years of his life in close attention to one study—the history of the ancients, their wars and enterprises, their heroes and their victories, their cities and temples, their orators and statesmen—when he looks on their philosophy as the highest attainment of human wisdom—when he reads of their deeds in the high-flown poetry of Homer and Virgil—when, in the warmth of a youthful imagination, he paints their actions, if possible, in brighter colours than even the poets themselves have done, and takes his imaginations for realities—when he becomes infected with the admiration for martial glory, and thinks nothing so noble as war—when he attaches to virtue the meaning given to it by the Romans, and looks upon animal courage as one of the highest attributes of human nature:—when, I say, he does all this, and at the same time knows little or nothing of the grandeur of modern science—when he has not the faintest conception of the gigantic mass of knowledge collected by the philosophers of the present day—valuable knowledge, ennobling knowledge, knowledge which enlarges the mind, and advances mankind physically and mentally—when he knows nothing of what is *done*, as well as what is *known*—nothing of the wonderful achievements of modern ingenuity, nothing of the almost miraculous results of the applications of science to the arts and manufactures:—under all these circumstances I ask, is it not probable—nay, is it not certain—that he will get up from his studies with a prepossession in favour of the ancients?—a prepossession which will tinge all the opinions of his after life—which will lead him to admire all that is old, in virtue of its antiquity—which will lead him to make wrong estimates of the beautiful and the noble—a bias, in short, which will be an injury to himself and to society.

This is a very interesting subject, one on which much more might be said, were it not irrelevant to the character of this publication; and as it is, these remarks are only admissible in virtue of their relation to architectural precedent. Under these impressions it is that I come to the conclusion, that the prejudices of society in favour of what is ancient are to be mainly ascribed to classical education, and that the readiness with which architects accede to the dogma of the unsurpassibility of ancient architecture is probably attributable to the same cause.

I quite agree with the opinion, that the study of existing specimens of architecture is necessary for the cultivation of taste, and that taste requires education as much as any other faculty, and I never for a moment intended to imply any general disrespect for the works of antiquity: on the contrary, I admire many examples, both classic and Gothic, perhaps as much as any one. But there is a great difference between admiring an object because it is really beautiful, and admiring it because it is old, or because it is the work of a certain people. There is a great difference between praising what is worthy of praise, reserving to one's-self the right of censuring what does not please, and subscribing to a wholesale approval of everything. There is a great difference between studying examples handed down to us with a view to the cultivation of taste, and studying with the intention of copying.

H. S.

Derby, Feb. 16.

P.S. In the original paper, page 23, second column, and the third line from the bottom, for "spurn" read "spread."

FRESCO PAINTING.

A Paper by JOHN WHITE, *Fellow, relative to two Tablets of Slate covered with Pozzolano and Stucco, and painted in Water Colours, read at a Meeting of the Royal Institute of British Architects, January* 31, 1842.

As the public attention is at present directed towards ornamental wall painting, particularly to the mode called *Fresco*, I have thought that it may be interesting to the Royal Institute to inspect two preparations made in the year 1824, on which have been painted in water colours subjects calculated to demonstrate that there exists a capability of painting on a permanent base, and with equally permanent colours.

The mode which has been adopted, was to cover two tables of slate with a coarse clay Pozzolano of British manufacture, and upon the surface to trowel with a glass float a thin stucco, composed of finely-ground lime and fine flint Pozzolano, mixed with weak alum water.

The paintings were executed before the stucco was thoroughly dry, and on them was added a thin solution of white wax in spirit of wine: this was done in order to insure the colours from being washed off when the paintings required to be cleansed, which has recently been done.

Seventeen years have elapsed, and the paintings are in the same condition as when first done; and I believe they will endure for any period of time. The tablets were prepared by Mr. Henry Crace, who painted that which is of an oblong form; the upright one was painted by a student of the Royal Academy, since dead, of the name of Robinson.

The advances recently made on the Continent in the decoration of buildings, by the introduction, or rather the restoration, of fresco or wall painting, has led me to observe that historical painting is capable of being executed in this country, and of being employed as an embellishment of our public edifices on a suitable basis, and to congratulate the Institute on the sentiment which is rapidly progressing, that the artists of England ought to be patronized in the enlargement of their ideas, by offering them the walls of our newly-constructing buildings as fields for their exertions on an expanded scale.

That this sentiment may not be checked, it is hoped that the Royal Institute will, by its expressed approbation, assist in forwarding every effort which it shall deem worthy its attention, and that the sense of the country generally will exhibit itself in favour of such patriotic labours as those which the late James Barry has displayed on the walls of the great room of the Society of Arts in the Adelphi, unfortunately, alas! too little imitated or patronized since their execution, now much more than half a century ago.

One difficulty in water painting on stucco has always presented itself, namely, that arising from the caustic quality of the lime used destroying most colours of a metallic or vegetable composition, leaving few more than the earths as proper articles to be employed by the painter on fresh walls; and when the walls are become dry, then the water colours adhere ill, and never are brilliant.

To remedy the evil, it will appear, on the inspection of the tablets now presented, that the surfaces they exhibit are not only sufficiently smooth to admit of vast facility or rapidity of execution, but that, inasmuch as the quantity of lime used in their preparation is small, it has not materially taken away the power or brilliancy of the work. In the upright tablet, which represents a copy of a fragment of a cartoon by Julio Romano, in the possession of Wm. Lambert, Esq. of the Woodhouse, Finchley, Cologne earth and a little blue has been used, diluted with water, in which a little shell lac was dissolved, by pounding it with borax, this solution making the colour pass very freely with the painting brush, and only tinting the mixture by the rose colour arising from the lac—in my opinion not at all objectionable. In the year 1825, this picture was shown at the Society of Arts, where it was washed, and rather rudely rubbed by some persons in their investigations as to its permanence. It has never been touched since that period, excepting that within a few days it has been rubbed with a flannel, to remove the dirt and smoke on the surface. The oblong tablet was painted, not in my presence, by Mr. Henry Crace. I am not acquainted with what solution he used with his colour, other than that it was water; but it is not permanent against washing.* Respecting it, it is to be observed that the artist, in proceeding from the left to the right, has evidently improved, and that there is great delicacy in the shading of the figure on the right, more indeed than I have remarked on any other surface, excepting enamel.

There is a little splendour on the face of both pictures, but it does not amount to the glare of oil paintings. I persuade myself that at almost any distance from paintings executed in this mode, what they intend to represent will be conspicuous, whether observed far or near, with almost equal advantage to the spectator, which is not the case with oil painting.

I have noticed in my letter, that the stucco which has been applied on the face of these tablets has been composed with very fine ground lime and calcined flint reduced to a powder, mixed with a little alum water, and trowelled on with a glass instrument. These materials have been smoothed down till the surface was sufficiently perfect, but yet not so triturated as to destroy the setting quality of the lime: great care is to be observed in this particular, and the skill of the workman is to be called into action. I need hardly notice, that it is the combination of the mechanical disposition of the fracture of the pozzolano flint and its burnt nature, which produce the strong adhesion and strength of the whole plaster, as most architects now admit this to be the fact. It was well known and understood by the Romans, who so extensively used the natural as well as the artificial burned earths.

This latter observation leads me to the importance of reflecting on the necessity of constructing buildings with materials which are incompatible, either by working them, as it were, stone and stone, or brick and brick, so united by workmanship as that there should be no shrinking, either in the foundation or superstructure; and that no wood band should exist in them, but that the union of the materials should be accomplished by a cement which, neither by exsiccation, by frost, or by moisture, shall shrink or perish, for it will be a waste of effort to employ artists' labour on substances which will neither resist the ordinary effects of time or acccident. Perhaps it may be said, that when walls have become settled, as it is called, that little danger can arise subsequently. This, however, is not always the case, as some seasons (in this country especially,) have very injurious action on buildings, and many salts escape from sands, stone, and lime, little expected by architects. Now, in properly burned, properly combined, and properly worked mortar, (the solid ingredients of which have passed through fire,) little change need be calculated upon; hence it probably is that pozzolano has been found to be the best building sand, though it is true that that which is imported is frequently brought from the shore of the Mediterranean, where the sea water has been, wherefore it necessarily partakes of the variable quality of the salt, and consequently is inferior to that fabricated of our own earths properly prepared and selected.

To return to the paintings exhibited:—it is hoped that the Institute will make allowance for their being merely experimental. Doubtless, much improvement will take place, should there be made any future attempts: as they are, they will perhaps show, that for such a city as London, the mode used is proper and cheap for decorative and historical painting; that the substance is, as well as the paintings, of a permanent nature; that the surfaces are such as neither to harbour dust or dirt; that they are easily cleansed, and can be employed for the most magnificent and talented displays of the efforts of our rising artists.

ON EARTH WORK, EXCAVATION, CUTTING, AND FORMING EMBANKMENT UPON RAILWAYS.

ARTICLE I.—GETTING, FILLING, AND TIPPING.

> "Modern practice has reduced it to a price per cubic yard."
>
> *Professor Vignoles' Lecture, Dec.* 1841.

SIR—I need not occupy your space in any introductory remarks on the importance of the price per cubic yard for earth work, both to the profession and the public, and with your assistance I will endeavour to show what it is on a medium cutting, or what in the execution can be taken off at a single lift, when the material is common earth, the eye of practice alone is able to proportion the cost when the material is of a harder or more obdurate nature. I shall fine my present remarks to the quantity that can be moved or carried into embankment per man per day from the cutting, the rate of wages of the excavator at the time will then show the cost of getting and filling. The cutting I am about to describe was in the line of railway, or what is called *back-cutting*, in contradistinction to earth got out of the line, which is called side-cutting, it consisted of good gravel, covered with a varying depth of vegetable mould, and a small quantity of brick earth, and would average in depth 14 feet, and one mile in length, and was used to fill a valley of similar extent. The wagons used were estimated to contain 2½ cubic yards each. The men were counted four times each day, and the average taken on the number of men employed. The wagons also were counted daily. The time of year was the most favour-

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[*] I fear it was white of egg, too much used by ancient painters on walls and stone.

able to show the action of change of weather on the result, also the effect of thaw after frost in assisting the operation of the excavator. In the first column is the date, in the second the number of days' work made in a week, which divided by the days will give the number of men. In the third column are the number of wagons of 2½ yards each carried into embankment, and in the fourth column the number of cubic yards moved per man per day in the excavation.

1837	*No. of days work.*	*No. of wagons.*	*Cubic yards.*	
Jan. 7	348	920	6⅐	
14	291	831	6 2/10	
21	354	950	8	
28	189	466	8 2/10	Hard frost, thermometer 20° below zero—work limited on account of tenacity of earth.
Feb. 4	85	171	5	
11	232	733	8	
18	359	1147	7 nearly	
25	419	1140	6 2/10	
Mar. 4	458	1630	9 nearly.	Work easier on account of thaw.
11	458	1440	8 nearly	
18	387	1238	8 full	
25	458	1263	7 nearly	
Apr. 1	463	1276	7 nearly	
8	479	1569	8 full	

The quantity removed and carried into embankment in one tip was nearly 400 cubic yards per day, which I consider very fine work. The width of cutting at the formation level was 31 feet with slopes of two to one, and the width of embankment, out to out at top of slopes, 34 ft. 6 in., which would confine the deposit to that width, as the embankment was carried to the full height of bottom of ballasting at once, and not in layers.

From the above table it will be seen that eight yards is nearly the quantity moved per man, and if the wages be 3*s* per day, the price per yard will be 4½*d*, which is the fact under the circumstances above stated. The work was carried on vigorously, but not pushed night and day, and every modern operation was taken advantage of, viz., gulletting, falling the earth by gravity over a bench left in the bottom for the purpose. The difference between the expence of excavating in side cutting out of land not in the line of railway is a small fraction cheaper, but the amount in value of plant is greater.

The above gross results are more satisfactory to my mind than the most careful division of the men into getters and fillers, as whoever has seen a work in full operation must be aware that some are gulletting, some filling, some carving under, and some filling into wagons, others wheeling at top with barrows, some casting out at bottom, and all contributing their mite to the same set of wagons, and in many instances to the individual wagon. I cannot omit to mention that I found my results exactly to coincide with those of Mr. James Day, in his Treatise on the Construction and the Formation of Railways, who states eight cubic yards as the average that is cut and loaded by each individual; his maximum having reached to twelve, and his minimum to six. In the detailed account of how much per man excavated you will find that my minimum is one only less than Mr. Day's, and that minimum was on account of the extraordinary frost; but that the ratio of my minimum amount to his is much smaller than in the maximum, his being twelve, and mine only nine, and that in only one instance. Mr. Day does not state in what period of the year his observations were made, nor in what year, or the nature of material, he only states that the locality was Durham; my observations were made on a portion of the Great Western Railway in Buckinghamshire. Mr. Day's book reached a 2nd edition in 1839, and I believe is the only writer who has entered into much detail, which, however, he does not give.*

The lectures of Professor Vignoles at the London University College, reported in the Journal, at the commencement has had a powerful effect, and I hope his wishes expressed in his first lecture will be accomplished. "To popularize the knowledge of engineering as a means of benefitting the public at large."—*(C. E. & A. Journal, Feb.* 1842.*)*

I have introduced the above remarks, although a little irrelevant to the subject, knowing as I do the prejudice that prevails against scientific knowledge. I will now proceed to notice the relative quantity of earth removed by estimation of the wagon at 2½ cubic yards, and by measurement with the tape. In the period from Jan. to March, 19,660 cubic yards by measure were removed, and 23,570 cubic yards by wagon; from Jan. to the end of March 28,834 cubic yards by measure were removed, or 29,912 cubic yards by wagon; the wagon being in excess both for the long and short period, but not in a greater ratio than it would be were too indifferent parties at different times to use the tape; indeed, 2½ cubic yards per wagon was so well established, that the men were indifferent whether they agreed per yard or per wagon, the price paid per wagon was 10*d*. Another coincidence which show that the foregoing remarks are founded on sure data, is that 2½ cubic yards at the rate of 4½*d*. per cubic yard nearly agrees with both the yards per man, and the rate of remuneration and estimated load of each wagon.

The following table will also be instructive, as showing the proportionate effect of small or large gangs of men on the quantity turned out. I will not specify the times *seriatim*, but merely observe that it was over the same period as the former table, and the same wagons were used. In the first column are the number of men employed at one time, in the second the number of days, and in the third the number of wagons employed, and in the fourth the price per cubic yard.

Men.	*Days.*	*Wagons.*	*Price per yard.*
15	5	140	4½*d*.
72	4	846	7 upward
74	1	192	6 above
74	4	761	6
75	4	847	7
80	1	240	7½
83	4	1045	8 above
80	4	742	5½
86	1	248	7

From the above table it will be seen that, like all questions, this has two sides, viz., that the hurried work cost the most money, and that when the work is not carried on with sufficient vigour, the same effect is produced. The price of 4½*d*. will be seen is a fair estimate when the work is carried on with a fair proportion of hands. The sub-contractor or gauger was paid 6*d* per cubic yard, for which he had to superintend the navigation and the finding of shovels, tools, and sharpening picks, advance the men money when come off *tramp*, lay down the temporary road, including turn-outs, shunts, crossings, boxes, spurrings, &c. take up and relay the road at the gullet and tip-head, as the work advances both in the excavation and the embankment, and to keep the road in repair, and tip or turn the dirt. The price he paid for tipping was 13*s*. 6*d*. per hundred wagons, or nearly ¾*d*. per cubic yard, leaving ½*d*. per yard for roads, and ¼*d*. for superintendence. He was advanced subsisting money weekly, after the rate of 2*s*. 6*d*. per day per man from the time-keeper's return, and his work measured every fortnight. There being the following checks, viz., time, tape, and estimated quantity per wagon: out of the ¾*d*. per yard, the price of keeping up the road, ½*d*. per yard, was retained in hand as security until the final measurement at the completion of the cutting. The price of 6*d*. was for the bulk of the excavation, some portion of the bottom, say three feet, in depth, being taken up back-handed (that is, as the work was cleared up, and the temporary road taken up) was paid for at the rate of 7½*d*. Again, at the commencement of the cutting at the balance level, where cutting and embankment commence, barrows were used for a short way into the hill before the rails were laid and wagon-work commenced, the prices varying from 3*d*., 3½*d*., 3¾*d*., 4*d*., 4½*d*., 5½*d*., 6*d*., and 7*d*., the latter being for a distance of about sixty yards, barrow-work being rated at about 5*d*. per cubic yard for the first run of 20 yards, and 1*d*. per additional run, when the tenacity of the earth requires no getting, so that the earth can be as easily excavated as refilled.*

Again, the top surface of cuttings and the seat of embankment are usually uncallowed for the purpose of resoiling the slopes. The uncallowing and resoiling together, not each separate operation, must be taken at the lowest price of 3*d.* and 3½*d.* Setting the above low price and the greater price of 7*d.* for the barrow-work against each other, and taking into consideration the comparative small cubic quantity of each in comparison with the bulk or body of the cutting, I do not think that the medium price of 6*d.* will be materially influenced. Furthermore, the effect of the gradually increasing "face," or depth of the hill from the balance level of cutting and embankment to the summit acting in favour of the operations of the excavator, will also much tend to equalize the two prices.

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* I do not think any information in detail is to be found in the "Public Works of Great Britain," the "Transactions of the Institution of Civil Engineers" (who have however this year attempted to remedy the defect by offering a Telford Medal on the subject, viz., on the various modes adopted for moving earth in railway tunnels, cuttings, or embankment, with the cost thereof), in the "Papers of the Corps of Royal Engineers," "Wood on Railways," "Tredgold on ditto," "Brees' Railway Practice," the "Book of London and Birmingham, and Grand Junction Railways," the "Railways of Great Britain and Ireland," or indeed in any book professing to treat on the subject, excepting the one already mentioned.

Much time would be saved to parties entering on a new course of study if individuals connected with any particular subjects for study, would communicate the results of their reading and practice to each other. A bold attempt to carry out this is being made at the Literary and Philosophic Institution of this town (Newcastle-on-Tyne.)

* A run is 20 yards, allowing for the inclination, although when on descending ground it is taken at 25 yards, but in most cases the level and ascent or descent, are computed as equivalent, and 20 yards is used as the measure in practice.

In conclusion I will glance at what you have already done in your Journal on the subject of earth work, which I think will more fully shew the value to the public and profession of the preceding tables, and the correctness of your views in the review of "A Practical Inquiry into the Laws of Excavation and Embankment, by a Resident Assistant Engineer," in the *C. E. & A. Journal*, vol. iii, 1840, p. 391, to which I most respectfully call the attention of your readers; as also to vol. iv., p. 417, where the performance of the American horse-scoop is noticed, and the quantity removed an average distance of 34½ feet per scoop per day, is stated to be 40 yards, and the cost 4¼*d.* to 5¾*d.* per cubic yard, rating the hire of scoop and driver at 12*s.* 5½*d.* per day, each scoop contains $\frac{1}{10}$ of a cubic yard; also to page 59, vol. v. for 1842, where Professor Vignoles in his 5th lecture, on earth work, states that "the causes that have thrown the railways of the Continent into the hands of the English contractors to be the 'finical exactness with which they (the French) calculate the expense of removing the first 100 yards, then the next 25 yards, and so on increasing until they get to 300 yards, beyond which the price is enormous." This will form the subject of my next communication, and for the present I subscribe myself, with sincere thanks for your former kindness, to be,

Yours obediently,

St. Ann's, Newcastle-upon-Tyne. O. T.

ON ARCHITECTURAL CRITICISM.

SIR—A knight, who has just entered your lists with his vizor down, having *en passant* permitted me to hear a little harsh voice, which it may be *can* sound agreeably, I have thought it quite as well to whisper a few words in his ear; not because, under the notion that he disesteems me, I would descend to parley, but because from his appearance and "*attitude,*" I am quite sure I should be addressing one to whom the affectation of contempt is more natural and becoming than would be the reality of that feeling.

Changing then my position, I had thought that no one, who presumes to love abstract speculation, would deny, that however deficient my papers may be, however in their *direct* tendency they may bow to the very able paper of H. S., yet, that upon that most delicate tissue of thought—the philosophy of taste (out of which emanates so much that is refining to us as students), I had not disgraced my subject, and that in an attempt to establish the poetry of an art which I love, I could have done no less than discuss those elements from which our emotions arise. My reasons for commencing the "Hints on Architectural Criticism," were upon the showing that critics very often debased, by their weak and capricious opinion, the art they professed to extol, and that, as a consequence, that art was held inferior to the art of the sculptor and the painter, and so in order to elevate our art, I found that the philosophy of our claims to the rank of a fine art should be clearly made out, otherwise we should be in the same position as we were.

It is upon these grounds that I have tried to show how those arts which are not descriptive may maintain an influence over the emotions.

If J. L. will tell me that he is indifferent to my attempt, I must I suppose believe him, but I cannot help thinking that as a lover of art he must know, (whatever he admits) that the more we can establish the philosophy of our claims to a rank disputed by many, and the more our inferior critics see and feel the foundation of our claims, the more honourable will be the defence of our art.

I only ask, Sir, of J. L., disguised as he is, not to show his dislike in the ignorant and common way of sneering at what (he says) he does not understand, but to dispute in the manner of a gentleman for that truth which, as a gentleman myself, is all I wish to establish.

I am, Sir,
Yours very obediently,

Feb. 9th, 1842. FREDERICK EAST.

ON STAIRCASES.

To the Penny Cyclopædia we are this month indebted for an interesting architectural article, upon the subject of staircases, which not only contains very far more information than is to be met with in any other work of the kind, but a great deal of excellent original comment. Hitherto encyclopædia articles of this class have usually been very meagre and unsatisfactory, and have consisted of little more than compilation and repetition, without any attempt to supply previous deficiencies. The Penny Cyclopædia, on the contrary, displays unusual carefulness of execution in its architectural department, and in the articles of architectural biography, in proof of which we have only to refer to *Ohlmuller*, *Oriel*, *Portico*, *Pulpit*, *Rodriguez*, *Roman Architecture*, *Rotunda*, *Rustication*, *Saloon*, *Sansovino*, *Scagliola*, *Scomozzi*, *Skylight*, and *Soane*. Very few of these have till now obtained any notice at all, unless a brief definition of their meanings deserves to be so called; nor is it always that even that is to be found. In this respect, therefore, the Penny Cyclopædia manifests a very great improvement upon all its predecessors. Nevertheless there might be some additions and enlargements; and we would suggest to the proprietors of the work, that, on its completion, all the architectural articles (including the biographical ones,) should be collected and reprinted in a separate form; and when we say reprinted, we do not mean verbatim, but that they should be revised and extended, and illustrated with additional drawings. Were this done, we should have what is still a desideratum—a good architectural dictionary; in which opinion most of our readers will, we think, concur with ourselves, after perusing the annexed extracts from the Penny Cyclopædia.

"It was not till about the time of Elizabeth that staircases began to be planned more commodiously in this country, and made a decorative feature in the interior of a mansion. But though they were greatly improved, the flights being made wider, and the steps parallel to each other, with intermediate landings or resting-places between the several flights, and although considerable decoration was bestowed upon them, the walls being panelled, and the parapet of the stairs formed either by richly-carved balusters, or open fretwork, frequently with heraldic figures of animals on the pedestals at the angles of the different flights—the staircase itself was usually enclosed within a comparatively small area, so as to admit of no general view of the whole of it, there being very little open space, or *well*, as it is termed; sometimes none at all. The staircases at Aldermaston, Berks, Crewe Hall, Cheshire, and Knowle, Kent, may be taken as examples of the kind. At a later period staircases in mansions of a superior class were made disproportionably spacious, being upon a scale as to size with which the apartments themselves were not at all in keeping.

"The planning of a staircase is generally considered one of the most difficult matters in internal architecture, and it is certainly one that requires great consideration. Yet there is no particular difficulty, except where, as is generally the case in moderate-sized houses, the architect is cramped for room; more especially if, while restricted in that respect, the ascent from one floor to another is greater than usual. The number of stairs and the space required for the convenient arrangement of them, are easily estimated when the height of the ascent from one floor to another is given, and the dimensions are determined for the risers and treads. Stairs are technically described as consisting of *Risers* and *Treads*, the former being the fronts or heights of the steps, and the other their flat surfaces or breadths. Stairs are further distinguished as being *Flyers*, those which ascend straightforward; and *Winders*, which having their treads triangular, coming quite to a point at their ends next balusters, afford no footing there, and ought consequently to be avoided whenever it is at all practicable to do so. A *Flight* is a consecutive series of stairs in the same direction, or between one *Quarter-space* or *Half-space (Palier de repos)* and another, which last are short intermediate landings, serving to lessen the fatigue of a continuous ascent, by subdividing it into shorter flights. For the area containing, or rather constituting, the staircase itself, we have no distinct term in addition to the general one, similar to the French *Cage*, the Italian *Gabbia*, and the German *Treppenhaus*.

"We proceed to notice the most convenient proportions of the stairs themselves, as to height and breadth, for their length. As to the breadth of the flights, that is comparatively arbitrary: it should never be much less than four feet, so as to allow two persons to pass, except in back-staircases; but it may be as much more as the space will permit, or the effect aimed at in the design may require. The best general and what may be considered standard proportions, are 6 inches for the risers, and 12 inches for the treads; though from 6½ to 7 inches may be allowed for the former, and only 10 for the latter, in secondary staircases. In those of a very superior kind, on the contrary, the risers do not exceed 5 or even 4 inches (less height than which last would be more fatiguing than convenient), and their treads are then made from 14 to 16 inches. The height, therefore, to the landing of the floor to be reached being given, it is easy to calculate either how many risers of a certain number of inches will be required, or what must be the dimensions of the risers and treads, in order to ascend within the space allowed. Supposing the first-mentioned height to be 14 feet, and the risers 6 inches, two risers will be equivalent to one foot of ascent, and consequently twenty-eight risers will be required, or twenty-seven treads, the upper landing being the tread to the last riser. In such case, hardly less than an area of 20 by 8 feet, on the level of the upper floor, would be sufficient for the staircase, unless there were winders instead of quarter-spaces, or of a single half-space between the two flights. The number of risers required is ascertained by reducing the given altitude of ascent to inches, and dividing it by the height of the risers: thus, taking the altitude as before (14 feet), and the risers at 5 inches, there must either be 33 risers a trifle more than 5 inches each, or 34 a trifle less.

"Palladio, and others following him, have laid it down that the staircase ought to be seen immediately on entering a building; but it is impossible to establish any positive rule for what must depend upon particular circumstances, and this is by no means the best as a general rule. In a public building, or place where strangers go in and out without inquiry, it may be desirable that the staircase should present itself at once; but certainly this is not the case in private mansions. On the contrary, it is in every respect better that the staircase should be kept out of view until the first vestibule has been passed through, and that it should be placed as remote from the entrance into the house as the plan will admit, both in order that the approach to it may be lengthened, and that, in case it has any architectural pretensions at all, it may strike the more by not coming into view at once. At all events, only the lower part of the staircase—no more than is sufficient to indicate its situation—should be visible from the entrance, otherwise it will be inconveniently exposed; and if there are doors to several rooms on the upper landing, persons passing from one to the other would be seen from the hall. It is, therefore, a great error to place the staircase, as is sometimes done, in the first or entrance hall of a mansion, because, in addition to the inconvenience just pointed out, such hall must be made the height of two floors, and consequently, if otherwise suitably proportioned to such height, it will be the most spacious and loftiest room, and so far be attended by a degree of effect which, instead of being afterwards increased or kept up, is greatly diminished. Such arrangement also cuts off the communication above between the rooms on one side of the hall and those on the other, except there is a gallery or continuation of the landing carried over the entrance."

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"One of the most simple and effective yet least common arrangements of a staircase, is that which may be described by the term *Avenue staircase*, the stairs being continued in a straight line, though broken by *spaces* into a succession of flights, within what would else be a level corridor or gallery, and occupying its entire width. There is something particularly noble and majestic in a staircase of this kind, for although it may be narrow, considered as a gallery, it looks unusually spacious as a staircase, the *flight* itself being wider than those of staircases placed within a much larger area. Besides which, the whole is more regularly disposed, and forms a more striking piece of perspective. Still simple as such plan is in itself, it is by no means adapted to general application, because, although it requires only moderate width, it requires considerable length, short flights, and ample spaces between them, and stairs with low risers and broad treads; otherwise the descent as viewed from above, being in a straight line, looks precipitous, or at least has no dignity of appearance. Another circumstance which limits a staircase of this kind to particular cases is, that in order for it to produce proper effect, the height to be ascended should be very moderate, hardly more than seven or eight feet; for else the space at the foot of the stairs looks confined, and the upper flights scarcely show themselves from that station. Hence, though it may be referred to as an instance of an avenue staircase, the one leading to the keep or round tower at Windsor Castle is more remarkable than beautiful or grand, leaving decoration out of the question; the altitude ascended being so very great. Sir John Soane has given some ideas of the kind in his designs for a "Scala Regia,"—a favourite subject with him; and he executed such a staircase, though upon a more limited scale, for the royal entrance to the House of Lords. The width of that staircase is only 10 feet, by 49 in extreme length, and the ascent 9 feet. Though not free from little conceits, the whole has considerable effect, as may be judged from the perspective view of it in vol. I. of the "Public Buildings of London," by W. H. Leeds, which also contains a longitudinal section of it. The staircase of the Chamber of Peers at Paris, designed by Percier and Fontaine, is another example of the kind, upon a larger scale, but not the very best, for the ascent is so great, that the columns on its sides, on the same level as the landing, look quite insignificant. That at Covent Garden Theatre also belongs to the same class, although it differs from the preceding in being extended in the upper part, by the landing being continued along its sides as a gallery divided from it by columns; the ascent is about 10 feet, in two flights. The National Gallery, again, affords instances of a different modification of the same arrangement, half the ascent being by an external flight in the vestibule, the remainder by another within the corridor leading from it; and though not exactly suited for such a building, the idea is pleasing in itself, and would produce a striking effect in one of less pretension.

"In public edifices or large mansions, whatever be the plan of the principal staircase, it is generally *branched*, that is, there is first a wide central flight, and then two other narrower ones branching off from it, one on each side, either at right angles to it, or as return flights parallel to it; and it is hardly necessary to observe that in all such staircases the *foot-spaces* are large, and that there are no winders. The staircase at Goldsmiths' Hall, which is parted off from the vestibule by a glazed screen, is an example of more than ordinary splendour, being lighted by a dome. The branching flights at right angles to the first, lead to a landing on each side, which has a double screen of Corinthian columns, so that the view across from side to side, in the upper part, is unusually rich. At Buckingham Palace, there is first a very wide flight, entered from between columns, branching off right and left in curved flights, the cage, which is about 36 by 26 feet, being curved elliptically on those sides or ends. In this example, the stairs rest upon a graduated podium or wall enclosing the space immediately beneath, which serves as a private passage behind; a mode frequently adopted in similar cases, being one which contributes to solidity and nobleness of appearance, and prevents that mass of shadow beneath the stairs which gives a gloom to the lower part of the staircase."

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"The staircase of the Fitzwilliam Museum, Cambridge, claims notice, not only on account of the richness of the general design, but of some peculiarities in its arrangement. Strictly speaking, however, this example can hardly be given as that of a staircase, according to the usual meaning of the term, the stairs being mere flights of steps in the entrance-hall. That in the centre is a broad descending one, leading down to the libraries, which are on a lower level than the hall; and on each side of it is a rather narrower ascending flight to the spacious landing carried around three sides of the hall, and serving as a statue gallery. Though the lower area is only 32 by 26 feet, consequently that of the floor very much less, owing to the space occupied by the flights of steps, that of the upper part on the level of the landing is 68 by 44 feet, the landing itself being about 17 feet wide. In some degree similar in plan, although very different in design, is the hall at Holkham, the seat of the Earl of Leicester, which has a noble flight of steps within a recess or tribune, enclosed by columns, which are continued along the sides of the hall.

"The grand staircase of the Reform Club-house, London, is an example, somewhat unusual in this country, though common enough in Italy, of what may be called an *enclosed* staircase; the flights are shut up between walls, and consequently there is no open *well*, nor can the whole be seen at one view. A plan of this kind, therefore, differs from the avenue staircase, merely in not being carried straightforward, but either returning in a parallel flight from the half-space or first landing, or having the second flight at right angles with the first. The last is the case at the Reform Club-house, where the staircase consists of three enclosed flights, the last being a return one to the first, and landing upon the gallery around the upper part of the inner hall or saloon. That at Burleigh, too, is similarly planned. The same mode may be adopted for circular or semicircular as well as rectangular plans; and one advantage attending it is, that, while the ascent itself is as spacious and commodious as if the whole were entirely open, there may be a secondary staircase for servants, shut up within the larger one."

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"The architectural effect of a staircase will greatly depend upon the mode of lighting it. Where it is carried up only one floor, the best mode is to light it entirely from above, either through a dome or lantern in the ceiling, or by making the upper part of the walls just beneath the ceiling a continued lantern. If there are windows on the landings of the several flights, the effect will be improved by their being filled with stained glass, especially if towards a back court; or, if a conservatory can be carried out on the level of the first landing, so as to show itself through glazed folding-doors, a very pleasing and cheerful effect is obtained, even though the conservatory itself should be hardly more than a glazed viranda. As to material, stone is greatly preferable to wood for stairs, if only on account of greater security in case of fire; in lieu of stone, cast-iron may be employed. Marble is very rarely used for stairs in this country, and whenever it is, it should be left unpolished on the treads, or it would be dangerous to descend them. The same remark applies to stairs of wainscot, unless they are carpeted nearly their entire width."

NAVAL ARCHITECTURE—STEAM VESSELS.

WE have, at very considerable trouble, formed a complete Table of proportions of the whole of the timbers, with but few exceptions, used in the construction of Timber-built Steam Vessels. We believe that this table is the first of the kind that has appeared in print, and doubtless it will, we hope, prove a valuable acquisition to all parties connected with steam navigation, and become a model for forming similar tables of other vessels.

The "Royal Tar" and "Don Juan" were built for the Peninsular packet service; the first vessel is now on duty, and running between Southampton and Gibraltar, the other vessel was lost. The specification of the West India Mail Packets is very deficient; we understand that those built for this service by different builders vary in their proportions, excepting such parts as are described in the table.

ABBREVIATIONS.—mat., m., material; No., number; diam., diameter; th., thickness; mo., moulded; qr., quarter; A. O., African Oak; Am. O' American Oak; E. O., English Oak; E. E., English Elm; A. E., American Elm; D., Dantzic; M., Memel; N., Norway; R. P., Red Pine; Y. P., Yellow Pine; P. Poplar; P. D., Prussian deals; I., Iron; C., Copper; Perpen., Perpendicular.

All the figures which are not represented as feet or numbers are inches.

Name of vessel	ROYAL TAR.	DON JUAN.	W. E. MAIL PACKETS.
Date of construction	1832	1836	1841
Name of builders of vessel	Duffus & Co.	Fletcher & Fearnell.	various
Name of makers of engines	Duffus & Co.	Girdwood & Co.	various
Length of keel	155 ft.	180 ft.	207 ft.
Breadth of beam, moulded	27 ft. 10	29 ft. 4	35 ft. 9
Depth in hold	19 ft.	20 ft.	20 ft.
No. of tons (register measurement)	500 ft.		
No. of tons (builders' measurement)		$775\frac{50}{94}$	$1285\frac{14}{94}$
Length on deck	167 ft.	194 ft.	
Breadth on deck at shaft	27 ft.	28 ft. 2	34 ft. 6
Breadth over paddle boxes		$55\frac{1}{2}$ ft.	
Draft of water forward, light	10 ft.	11 ft.	
Ditto, loaded	12 ft.	13 ft.	
Ditto, aft, light	11 ft.	13 ft.	
Ditto, aft, loaded	13 ft. 4	14 ft. 6	
Rise of floor on half breadth	3	none	
Angle of bow at light water-mark			
Rake of stem or angle with heel	7 ft.	perpen.	
Rake of stern post	8	perpen.	perpen.
Sheer forward	3 ft.	1 ft. 6	
Sheer aft	2 ft. 6	1 ft.	
Keel—mat.	E. E.	E. E.	E. E.
moulded and sided	13	13 × 14	15
length of scarphs	3 ft. 6	5 ft.	4 ft. 6
No. of bolts in each scarph	6	6	
diam. of bolts in scarphs	$1\frac{1}{8}$	$\frac{7}{8}$	$\frac{7}{8}$
Stem—mat.	E. O.	E. O.	E. O.
sided at head		12 × 14	15
moulded and sided at heel	12	17 × 13	16
Stemson—mat.	E. O.	A. O.	E. O.
moulded and sided	12	13	12 by 16
Apron—mat.	E. O.	E. O.	
length on keelson	8 ft.	10 ft.	
sided	as stern	as stern	
Stern post—mat.	E. O.	A. O.	E. O.
moulded and sided at head	8 × 12	12 × 12	16
" on keel	14 × 12	25 × 12	21
Inner post—mat.	E. O.	A. O.	E. O.
moulded and sided at head	8 × 12	10 × 10	9
" on keel	14 × 12	10 × 14	16
Wing transom—mat.	E. O.	20	
sided and moulded	12	13 × 15	
Deadwood—mat.	E. O.	E. O.	
sided	as keel	as keel	
length on keelson			
Stemson knee—mat.	E. O.	E. O.	
length			
moulded at throat			
bolted, every	18	12	
diam. and mat. of bolts	C. 1	C. $1\frac{1}{8}$	
Fashion pieces—mat.	E. O.	E. O.	
sided	8	9	
length above transom	1 ft.	3 ft.	
Knights-heads—mat.	E. O.	E. O.	E. O.
sided	12	13	13
diam. and mat. of bolts	iron 1	iron 1	iron 1
Hawse pieces and chocks—mat.	E. O.	E. O.	
sided	10	11	
No. on each side	2	3	
hawse pipes, diam.	9	10	
Keelson—mat.	A. O.	A. O.	A. O.
moulded and sided	12 × 16	as keel	
bolted through	every floor	every floor and keel	every floor and keel
diam. and mat. of bolts	C. $1\frac{1}{8}$	C. $1\frac{1}{8}$	C. $1\frac{1}{4}$
limbers, every		4 ft.	
Engine keelsons—No.	4	4	4
mat.	A. O.	A. O.	A. O.
moulded and sided	12 × 16	14 × 18	18 by 15
bolted through	every floor	every floor	every floor
diam. & mat. of bolts under engine	C. $1\frac{1}{8}$	C. $1\frac{1}{8}$	C. $1\frac{5}{8}$
ditto before and abaft engine	C. 1	C. $\frac{7}{8}$	C. $1\frac{1}{4}$
Framing or Timbers.			
Built in frame?	Yes	yes	
Short floors—mat.	E. O.	E. O.	E. O.
in engine room moulded & sided	12	13 × 12	15 by 13
before and abaft engine room	10	13 × 10	11
at the cutting down		13	
at the heads, moulded		13	12
Long floors—mat.	E. O.	E. O.	E. O.
in the engine room, moulded and sided	12	13 × 12	15 by 14
before and abaft, at the heads, moulded and sided	10	10	$13\frac{1}{2}$ by 12
Futtocks—second futtocks—mat.	E. O.	E. O.	E. O.
between paddle beams, moulded and sided at heels	10	12 × 12	11
moulded and sided at heads	8	8 × 12	$10\frac{1}{2}$
in room and space, moulded and sided at heels	10	12	10
moulded and sided at heads	8	10	9
—— top futtocks—mat.	E. O.	E. O.	E. O.
in room and space, m. and sided	$5\frac{1}{2} \times 7$	8 × 12	9
forward and aft, mo. and sided	$4\frac{1}{2}$	6 × 12	8
bolted horizontally?	Yes.	yes	yes
distance between bolts	4 ft.	3 ft.	
diam. and mat. of bolts	iron $\frac{3}{4}$	iron $\frac{3}{4}$	iron $\frac{3}{4}$
Room and space—length of	50 ft.	60 ft.	70 ft.
space between floors	none	none	none
space between frames within paddle beams	none	none	none
filled fore and aft to turn of bilge?	yes	yes	yes
mat.	D	M.	R. P.
caulked within and without?	yes	yes	felted
shape of ends of futtocks	square	square	
how secured	dowelled	dowelled	
diam. and mat. of dowel	A. O. $1\frac{1}{4}$	A. O. $2\frac{1}{2}$	
Stern and counter timbers—mat.	E. O.	E. O.	
moulded and sided at head	$5\frac{1}{2} \times 4$	$6\frac{1}{2} \times 5$	
moulded and sided at heel	$7\frac{3}{4} \times 5\frac{1}{2}$	$8\frac{1}{2} \times 6\frac{1}{2}$	
Timber heads—mat.	A. O.	A. O.	
No. on each side	4	6	
moulded and sided	12 × 6	12 × 6	
Towing timbers—mat.	none	none	
No. on each side			
moulded and sided			
Diagonal iron plates—angle of, with keel	45°	50° to 60°	
space between	4 ft. 6	4 ft.	
width and thickness	$4 \times \frac{1}{2}$	$4 \times \frac{3}{4}$	
Thick streaks within board—mat.	A. O.	A. O.	
No.	3	5	
Mean breadth and th. amidships	$10 \times 3\frac{1}{2}$	$12 \times 4\frac{1}{2}$	
Stringer.			
Main deck or shelf piece—mat.	A. O.	A. O.	A. O.
moulded and sided amidships *	7 × 12	12 × 12	13 by 15

	Royal Tar.	Don Juan.	W. E. Mail Packets.
ditto and sided at ends	6 × 11	12 × 9	15 by 9
extent of abaft quarter deck	6 ft.	6 ft.	
Quarter deck stringer—mat.	D	D.	
moulded and sided	7 × 8	7 × 8	
Forecastle deck stringer—mat.	D.	Y. P.	
moulded and sided	7 × 5	8 × 6	
Fore cabin sole stringer—mat.	D.	A. O.	
moulded and sided, aft	9 × 7	10 × 8	
„ forward	6 × 7	7 × 8	
Saloon sole stringer—mat.	A. O.	A. O.	
moulded and sided	6 × 7	7 × 8	
Deck under saloon sole stringer—mat.	Q. O.	A. O.	
moulded and sided	6 × 7	7 × 8	
Stringer through engine room—mat.	A. O.	A. O.	
moulded and sided	7 × 7	10 × 8	
Clamps.			
Under main deck stringer—mat.	A. O.	A. O.	A. O. and D.
No. of streaks	1	2	3
breadth of each	12½	12	
thickness amidships	7	6	8
thickness forward and aft	5	4	5
under quarter deck stringer—mat.	D.	D.	
No. of streaks	1	1	
breadth and thickness of each	3½	4	
under fore cabin sole stringer—mat.	A. O.	A. O.	
No. of streaks	1	2	
breadth and th. of each forward	12 × 4½	10 × 3½	
„ aft	12 × 5½	10 × 3	
under saloon sole stringer—mat.	D.	A. O.	
No. of streaks	1	2	
breadth and thickness of each	10 × 4	10 × 4	
under cargo deck stringer—mat. and No.	D. 1	A. O. 1	
breadth and mean th. of each	11 × 4	10 × 3½	
under engine room stringer—mat.	A. O.	A. O.	
No.	2	2	
breadth and thickness	10 × 5	12 by 6	
Ceiling—mat. and thickness	D. 3	D. 3	
Deck—*Beams.*			
Paddle beams—mat.	A. O.	A. O.	A. O.
moulded and sided	20 × 16	22 by 18	12 by 18
length of scarphs	5 ft.	8 ft.	
No. of bolts in each scarph	8	10	
Paddle bearers—mat.	A. O.	A. O.	
No. on each side	1	2	
moulded and sided	18 by 8	each 12 by 10	
Crank beams—mat.	A. O.	A. O.	
moulded and sided	7½ by 8	9 by 11	
Hatchway beams—mat.	A. O.	A. O.	
moulded and sided	9 by 10	9 by 11	
Fore and aft beams of boiler hatch—mat.	A. O.	A. O.	
moulded and sided	14 by 10	14 by 10	
Beam at break of qr. deck—mat.	A. O.	A. O.	
moulded and sided	9 by 10	12 by 10	
Beam at after extremity of quarter deck—mat.	A. O.	A. O.	
moulded and sided	9 by 9	10 by 12	
Main deck beams—mat.	D.	D.	A. O.
moulded and sided	9 by 10	9 by 11	11 by 12
spaces	5 ft.	3 ft.	
Beams of quarter deck—mat.	D.	D.	D.
moulded and sided	9 by 10	9 by 10	6 by 7
spaces	5 ft.	3 ft.	
Beams of forecastle deck—mat.	D	D.	
moulded and sided	10 by 8	10 by 8	
spaces	4½ ft.	4 ft.	
Beams of fore cabin sole—mat.	D	D.	A. O.
moulded and sided	9 by 8	10 by 9	11 by 11
spaces	5 ft.	3 ft.	
Beams of saloon sole—mat.	D	D.	
moulded and sided	9 by 8	10 by 9	
spaces	5 ft.	3½ ft.	
Beams of cargo deck—mat.	D.	D.	
moulded and sided	9 by 8	10 by 9	
spaces	5 ft.	3½ ft.	
Beam across engine room—mat.	A. O.	A. O.	
moulded and sided	8 by 10	9 by 11	
Outside Planking.			
Garboard streaks—mat. and No. on each side	E. E. 1	A. E. 1	E. O. 1
breadth of each	12	13	as deep as the mould of vessel will admit.
th. at lower edge amidships	7	9	
th. at upper edge amidships	4	5	
th. at lower edge forward & aft	5	6	
th. at upper edge ditto	3	4½	
Bottom plank—mat. and thickness	E.E. 4 & 3	A. E. 4½	D. 4½
length of shiftings			
Bilge plank—mat. & No. of streaks	A. O. 4	A. O. 4	A. O.
mean width of streaks	7	8	
thickness at middle of streaks	4	5½	
thickness at upper side	3	4½	
thickness at under side	3	4½	
Bends or wales—mat. and No. of streaks	D. O. 3	A. O. 4	A. O.
breadth of streaks	10 by 3 = 30	4 by 10 = 40	
thickness at centre of streaks	6	6	6½
thickness at upper side	6	6	6½
thickness at under side	6	6	6½
Black streaks—mat. and No.	20	D	
mean thickness	2½	4	
Paint or sheer streaks—mat. & No.	A. O.	A. O. 2	A. O. 2
breadth and thickness	3½	24 by 4	8 to 3
Plan sheer or gunwale—mat.	A. O.	A. O.	A. O.
breadth and thickness	3	4	6
Top sides—mat. and thickness	E. O. 2½	A. O. 4	E. O. 3½
Stern and counter—mat. and th.	E. O. 3	E. O. 3	
Deck Planking.			
Main deck covering board—mat. and th.	A. O. 3	D 6	
Main deck water way—mat. & th.	A. O. 4	D 6	E. O.
flat of the deck—mat. and th.	D. 3	D 3	D. 3
copper nails, No. of lb. per 100.	14	15	
partners for masts—mat.	A. O.	E. O.	
gammoning chocks—mat.	E. O.	E. O.	
steps for masts—mat.	E. O.	A. O.	
Quarter deck, covering board—mat. and thickness	A. O. 2½	A. O. 4	
water way—mat. and thickness	A. O. 3	D. 4	D.
flat of the deck—mat. and th.	D. 2½	D. 3	D. 3
nailed or dowelled?	nailed	dowelled	
composition nails, No. of lb. per 100	14 lb.		
Cabin sole—mat. and thickness	N. 2¾	R. P. 2½	P. D.
iron nailed?	yes.	yes	
Cargo deck—mat. and thickness	N. 2¾	Y. P. 3	P. D.
Forecastle deck—mat. and th.	D. 2½	D. 3	
Fore cabin sole deck—mat. and th.	N. 2¾	Y. P. 2½	
Breast hook, upper deck—mat. and length	E. O. 12 ft.	E. O. 12 ft.	E. O. 14 ft.
Iron breasthooks, No. of	2	3	14 ft. long 5 ft. broad 3½ at ends
weight of 1st size	1 cwt. 2 qrs.	2 cwt.	
weight of 2nd size	2 cwt.	2 cwt.	
weight of 3rd size		4 cwt.	
Diagonal oak chocks—No. of each side	4	4	
breadth and thickness	9 by 4	10 by 5	
Sponsons—kind of	fiddle shaped	fiddle shaped	
length of tuck	4½ ft.	6 ft.	
Rails—quarter deck—mat. and th.	A. E. 3	A. E. 3	
stanchions—mat.	E. O.	E. O.	
moulded and sided	4 by 4	4 by 4	
Taffrail—mat. and thickness	E. E. 3½	E. E. 4	
breadth	7	8	
Fyferail—mat. and thickness	Am. O. 3	Am. O. 3	
breadth	7½	7½	
Forecastle rail—mat. and thickness	I 1¼	I ¼	
Bill board—mat. and thickness			
Paddle Boxes—stanchions—mat.	E. O.	E. O.	
moulded and sided	8 by 6	12 by 8	
plank—mat. and thickness	D. 2	D. 2	
ploughed and tongued	yes	yes	
Bulkhead abaft engine room			
stanchions—mat.	Am. O.	Am. O.	
moulded and sided	7 by 6	12 by 4	
plank—mat. and thickness	R. P. 2½	P 2½	
filled with sawdust	yes	yes	
Bulkhead before engine room			
stanchions—mat.	Am. O.	Am. O.	
moulded and sided	6 by 5	7 by 6	
plank—mat. and thickness	Y. P. 2½	Y. P. 2½	
ploughed and tongued?	yes	yes	

	Royal Tar.	Don Juan.	W. E. Mail Packets.
Deck houses—extent before paddle box	16 ft.	20 ft.	
extent behind paddle box	20 ft.	20 ft.	
top timbers—mat.	E. O.	E. O.	
moulded and sided	2½ by 3	3 by 3½	
spaces between	3 ft.	3 ft.	
stanchions—mat.	E. O.	E. O.	
moulded and sided	5 by 3½	7 by 5	
planking of top—mat. and th.	D. 2	D. 2	
ploughed and tongued?	no	no	
planking of front—mat. and th.	D. 1½	D. 1½	
ploughed and tongued?	yes	yes	
Front of poop, stanchions—mat.	E. O.	E. O.	
moulded and sided	4 by 4	6 by 6	
plank—mat. and thickness	D. 2½	D. 3	
Roughtree—mat. and thickness	Am. O. 3½	Am. O. 3½	
breadth	5½	6½	
Bulwarks, timbers—mat.	E. O.	E. O.	
moulded and sided	3½ by 3	4 by 3½	
spaces			
plank—mat. and thickness	E. O. 2½	D. 3½	
Skylights, No. of, in saloon	1	2	
length of	9 ft.	6 ft.	
breadth of	4 ft. 6	4 ft. 6	
height of	2 ft.	2 ft.	
Companions, main cabin, timbers—mat.	Am. O.	Am. O.	
moulded and sided	4 by 4	4 by 4½	
plank—mat. and thickness	1½	1½	
length	6 ft.	6 ft.	
breadth	5 ft.	5 ft.	
height	4 ft.	4 ft. 6	
Companion fore cabin—length	5 ft. 6	5 ft. 6	
breadth	4 ft. 6	4 ft. 6	
height	3 ft. 6	3 ft. 6	
Combings of hatchways—mat.	A. O.	A. O.	
moulded and sided	12 by 3	12 by 3	
of crank hatches—mat.	A. O.	I	
moulded and sided	18 by 2	10 by ½	
of deck houses—mat.	A. O.	A. O.	
moulded and sided	6 by 3	9 by 3	
of skylights—mat.	A. O.	A. O.	
moulded and sided	6 by 2	8 by 2½	
of companions—mat.	E. O.	A. O.	
moulded and sided	7½ by 3	8 by 3	
Side ladders—mat.	A. E.	Am. O.	
length	10½	10½	
breadth	2 ft.	2 ft.	
breadth and thickness of sides	9 by 1¾	9 by 2	
thickness and breadth of steps	10 by 1¼	10 by 1½	
Figure head, timbers of—mat.	E. O.	E. O.	
moulded and sided	6 by 4	7 by 5	
plank of—mat. and thickness	D. 1½	D. 2	
Figure head—height of	5 ft. 6	bust	
Cutwater, projection of, from stem	10 ft.	15 ft.	
thickness of, at outer extremity	3	5	
Stern, width across over galleries	29 ft. 8	34 ft.	
depth of, from quarter deck to name board			
round on, or projection beyond galleries	8	6	
Quarter galleries, projection of from side		3 ft.	
depth of, between mouldings	2 ft. 6	2 ft. 8	
length of, one side	6 ft.	8 ft.	
Rudder, kind of—mat.	E.O. common	E.O. common	rule joint 1 inch less than stern post
moulded and sided at head	12 by 14	14 by 16	
mo. and sided at tail at inner side			
„ at outer side			
Windlass, Winch and Crane.			
Carrick bitts—mat.	E. O.		
moulded and sided	18 by 4½	18 by 5½	
Pawl bitt—mat.	E. O.	E. O.	
moulded and sided	12 by 10	10 by 14	
Windlass—mat.	E. O.	A. O.	
diameter in middle	2 ft. 6	2 ft. 8	
„ at ends	2 ft. 2	2 ft. 2	
Length between carrick bitts	9 ft. 2	10 ft.	
Length of windlass ends	2 ft. 6	2 ft. 8	
Diameter of spindle	3	3½	
Riding chock?	no	yes	
Purchase wheels?	yes	yes	

	Royal Tar.	Don Juan.	W. E. Mail Packets.
Increase of power by ditto	7 to 1	9 to I	
Size of winch chain	½	⅝	
Diameter of chain barrel spindle	2	2¼	
Weight winch is warranted to lift	3 tons	4 tons.	
Size of chain of crane	½	⅝	
Radius of sweep of crane	10 ft. 6	10 ft. 6	
Diameter of crane pillar	15	16	
Material of crane pillar	cast iron	cast iron	
Diameter of spindle of chain barrel			
Steering Wheel—diameter (over all)	4 ft. 6	5 ft. 3	
No. of spokes	10	11	
diam. of spokes at smallest part	1¼	1½	
diam. of wheel spindle	1¾	2¼	
length of tiller or quadrant (from rudder centre)		4 ft. 3	
diam. of barrel at end of wheel spindle	8	9	
diam. of tiller at neck	3	3½	
„ at outer end	2	2½	
increase of power by the wheel			
DECK MEASUREMENTS.			
Paddle Box—height above deck	12 ft.	13 ft. 6	
kind of sponsons	fiddle	fiddle	
projection of sponsons	4 ft. 6	6 ft.	
Deck Houses—extent before shaft	26 ft.	20 ft.	
extent behind shaft	20 ft.	22 ft.	
width at paddle box	7 ft. 6	6 ft. 6	
width at fore end	7 ft.	6 ft.	
width at after end	7 ft.	6 ft. 6	
height at paddle box	6 ft. 6	6 ft. 6	
height at extremities	6 ft. 6	6 ft.	
Qr. Deck—length from stern post	50 ft.	52 ft.	
total length	54 ft.	56 ft. 6	
height above main deck	4 ft.	4 ft.	
Forecastle Deck—length	12 ft.	14 ft.	
height	5 ft.	5 ft.	
Breadth of vessel at after side of forecastle	11 ft.	13 ft.	
at fore side of deck houses	35 ft. 6	37 ft.	
at after side of deck houses	37 ft.	40 ft.	
at break of quarter deck	36 ft.	41 ft.	
at stern post	28 ft.	29 ft.	
at after extremity of qr. deck	27 ft. 5	28 ft.	
MASTS.*			
No. of masts	2	3	
Foremast—height above deck	52 ft.	58 ft.	
mean thickness	1 ft. 6	1 ft. 9	
distance from stem		38 ft.	
ditto from funnel		68 ft.	
Main Mast—height above qr. deck	60 ft.	64 ft.	
mean thickness	1 ft. 6	1 ft. 8	
distance from funnel	18 ft.	26 ft.	
Mizen Mast—height above qr. deck		52 ft.	
mean thickness		1 ft. 3	
distance from main mast		33 ft.	
Foretop Mast—height	60 ft.	64 ft.	
mean thickness	10½	11½	
Maintop Mast—height	60 ft.	64 ft.	
mean thickness			
Mizentop Mast—height		40 ft.	
mean thickness		8 ft.	
SPARS.			
Fore-yard—length	54 ft.	60 ft.	
thickness at centre	17½	18½	
thickness at extremities		48 ft.	
Foretop-sail Yard—length	40 ft.		
thickness at centre	10	11½	
thickness at extremities			
Main Gaff—length	40 ft.	42 ft.	
thickness at jaw	14	15	
thickness at outer extremity	5	5	
Mizen Gaff—length		32 ft.	
Bowsprit—length	34 ft.	36 ft.	
thickness at inner or lower end	18	20	
thickness at outer end	12	14	

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* All topmasts should be one inch in diameter for every yard in length in other words, their diameters should be one thirty-sixth of their length. The same proportion holds good for top-gallant masts.

Yards are proportioned as follows: namely, lower yards seven-tenths of an inch for every yard in length; top-sail yards five-eighths of an inch; and top-gallant yards six-tenths of an inch.

TABLE *(continued)*.

	ROYAL TAR.	DON JUAN.	W. E. MAIL PACKETS.
	—	—	—
Jib-boom—length	40 ft.	48 ft.	
thickness at inner end	12	14	
thickness at outer end	5	7	
Martingale—length	15 ft.	16 ft.	
thickness			
RIGGING.			
Size of fore stay—circumference	5½	6	
main stay	4½	4¾	
mizen stay	3½	4	
No. of fore mast shrouds	7	7	
main mast shrouds	6	6	
mizen mast shrouds		3	
funnel shrouds			
Size of fore mast shrouds	5	6	
main mast shrouds	4½	5½	
mizen mast shrouds		3½	
funnel shrouds	5	5½	
Funnel shrouds, rope or chain?	chain	rope & chain	
ANCHORS AND CABLES.			
Working anchor cable, size			
length			
weight			
Bower anchor cable, size			
length			
weight			
Cat heads—mat.	E. O.	E. O.	
moulded and sided	11 by 12	11 by 12	
Fish davits—mat.	E. O.	E. O.	
moulded and sided at heel	6 by 6	6 by 6	
moulded and sided at head	5 by 5	5 by 5	
Copper—weight per square foot at water line	28 oz.	28 oz.	28 oz.
on bottom	26 oz.	26 oz.	28 oz.
all bolts below water line copper if coming through?	yes	yes	and for 2 feet above

PROFESSOR HOSKING'S LECTURES ON THE PRINCIPLES AND PRACTICE OF ARCHITECTURE. KING'S COLLEGE, LONDON.

INTRODUCTORY LECTURE, January 24th, 1842.

IN the remarks with which I introduced my course on the ARTS OF CONSTRUCTION, last year, I intimated how much more extensively the term architecture applies, and how much more is embraced in the complete practice of architecture than is generally inferred from it, or understood from its application. I considered my duties then to be restricted to the consideration of the technical combinations of matter to form constructions, but I have now to treat of the mental skill and the regulated taste which direct the employment of the arts of construction, and of the means of acquiring such skill and taste, and of applying them in practice. These, together,—the mental skill to arrange and adapt, the technical knowledge to construct, and the regulated taste to dispose and decorate,—form the architect, and the result of the combination in his productions is architecture. The best constructions applied unaptly, or incongruously disposed, the most skilful arrangements for use, unsymmetrically disposed, or inconsistently decorated, or the most classically disposed and chastely decorated exterior to an ill-contrived plan, are alike unworthy the name of architecture and the reputation of an architect. Unless the arrangements for service and use are the best that the case admits of, unless the constructions are perfect in themselves and in their combination, be the materials what they may, and unless the dispositions for decoration, and the decorations themselves, be well proportioned and consistent, a work is undeserving to be distinguished as architecture. There must be excellence in letter and in spirit, in form and in substance, to constitute an excellent work of architecture, and it is only those who combine in themselves the skilful arranger, the tasteful disposer, and the sound and economical constructor, who can claim the character of architect.

The general acceptation of the term architecture is in its most restricted sense, the decorative disposition of buildings, or that which I refer to the regulated taste of the architect; but this is to take the chased and enamelled case for the watch, or the setting for the jewel. A quaint and often quoted writer of the 17th century says truly, that "the end of architecture is to build well," and that "well building hath three conditions, commodity, firmness, and delight." All these conditions, I have already said, must be fulfilled to constitute architecture, and more must be understood by them than the mere words in which they are expressed would appear to convey, but not more than they really imply. All the operations, of whatever kind they may be, necessary to the perfect fulfilment of those conditions, are included in the system of architecture, and consequently fall within the province of the architect to originate and direct.

I endeavoured, on the former occasion to which I have alluded, to indicate the line that might be drawn between the architect, commonly so called, and the civil engineer, constituting the latter the hydraulic architect; but the first step the architect finds himself called upon to take, the first subject that claims his consideration in any work that he may be employed upon, is strictly within the practice of hydraulic architecture, so that if the architect be not also, not merely informed, but skilled in that branch of practice, he is unfit to take the first step, to undertake the consideration of the first subject that presents itself in commencing the process of building well. An architect may be called upon—and who so competent as a thoroughly accomplished architect?—to choose or select a site for a town—or more commonly intrinsic circumstances, some peculiar advantage or advantages it may possess, in a commercial point of view or otherwise, dictate the site, and it devolves upon the architect to fit the site for the purpose to which it is devoted. Easy access by roads, which roads must be laid out and set out with proper inclinations, and with bridges and culverts to carry them over streams and gullies, and they must be cut, formed, drained, ballasted, and metalled, or otherwise paved; quays to the river or the harbour must be arranged and formed or embanked, and constructed, encroaching upon the tideway or widening the waterway, as the case may require; or, in the absence of natural facilities for navigation, it is a question for consideration and determination—can artificial navigation be obtained, and how and in what manner shall the site be best disposed of to take advantage of it? The site of the town must be drained, and the soil drainage taken off, roads as streets and open places within and about the town, must be laid out and disposed in such manner as to be best adapted for the buildings to be erected in and about them, and generally as to light, aspect, and ventilation; water must be led to, or raised by artifice within the site of, a town, and accumulate in reservoirs, from which it may be distributed for use and enjoyment. Many of these things may, indeed, be referred to the engineer or other extraneous practitioner, but most of them are generally left to chance, or to be created or corrected when the hard teacher Experience has pointed out what ought to be, or to have been, done. It may not happen, indeed, to very many to have towns to originate and design, but, almost every building or cluster of buildings—a nobleman's mansion or an establishment for manufacturing or other commercial purposes—a plain country house or a county asylum—a church or a palace—all make some demand, greater or less according to situation and circumstances, upon the skill of the architect in hydraulic works and constructions, and consequently demand, of every one professing himself an architect, perfect competence to originate and execute them. With reference to these considerations I may remark, too, that the widely extended and daily extending and improving colonies of this empire present a wide field of employment to the architect and engineer, and where every thing will be required of the practitioner single handed, or rather where he will be well and beneficially employed only if he can turn his hand to every thing—to drain a marsh as well as to raise a column, to build a church or a town-hall as well as to make a railway or to form a canal.

It is not often, perhaps, that the civil architect will have occasion for a knowledge of military engineering, but it is very desirable that he should be able to work with the military engineer, or rather, with reference to what the military engineer would deem necessary for the defence or protection of a town, whether from external force or from internal commotion, and to know how to make his arrangements accordingly. Gates and guard-houses are not of common occurrence amongst us at home, truly and happily, but such works are not the less in demand in some places, and the architect who might be called upon to assist the military engineer with the constructions that he may not be architect enough to design and direct, or to act in the absence of an efficient officer of that class, would be most unfitly prepared for the varied duties of active professional life, if he were then and in either case found wholly wanting.

An architect should, then, have an eye to defences and defensive erections in laying out towns of certain kinds and under certain circumstances; he would act unwisely to place a wharf or a landing-pier or jetty in that part of a harbour where a battery may be essential for its protection, or to raise buildings that would intercept the fire of a fort whose guns should range across their site.

The architect will be called upon for the exercise of skill and taste, guided by a thorough knowledge of the peculiar requirements of every class of a community, and of the community as such, in the distribution of the parts of a town, and of the various public and private erections and establishments that every civilized community requires, and especially with reference to the peculiar circumstances of the particular town and community. There must be public places, as open markets or otherwise, in or upon which some of the requisite public buildings may open and display themselves, and where fountains form ornamental and appropriate objects, and public places as parks and gardens for exercise and recreation, sites for public buildings, sites for the varieties of private dwellings, and places for manufacturing and commercial buildings and establishments according to their kinds and requirements. These are all to be provided and arranged to produce the greatest possible general convenience and advantage; and towards effecting this, the relative levels of the lowest floor of the buildings to the drainage level, together with the requisite provision for general ventilation, should all be settled, so that it be not left to chance or to the ignorance or caprice of individuals in building in detail, whether the town shall be pleasant and wholesome, or be the seat of discomfort and disease.

Operating in detail, the architect will have to study closely the means of securing what must be deemed essentials to every building. There must be convenience and facility of access to the building itself;—relief from water must be secured in every direction, and in whatever form water can present itself, from the earth or from the skies, by the foundations or by the roofs, and with this the relief of every building in which such can arise, of soilage, must be fully provided for; the admission of air is to be regulated and brought under control, to ventilate without establishing injurious draughts; and light is to be admitted and diffused so that every part of an interior may be appropriately and sufficiently lighted, and lighted from a general cource directly, or with as little recourse to borrowed and artificial lights as possible; equable temperature throughout the varying seasons is to be maintained by the exclusion of excess of heat at one season, and by the promotion and diffusion of heat to warm at another; and perfect facility of intercommunication to the fullest extent that intercommunication may, in each particular case, be desirable, between the parts of an interior, whatever may be the relative levels of the parts, or at whatever distance they may be from one another.

Next to the general essentials, which are as much so to a Penitentiary or to an Hospital as to a Palace, are the particular arrangement and distribution of each peculiar class of buildings. This does not admit of general definition, but to take one and a large class of buildings—dwelling-houses,—and their congeners, buildings which include offices for state, as palaces and other official residences, and houses which include offices for service, as professional, mercantile, and commercial houses, as well as domiciles:—every building of this class may be resolved into three departments—the public and the familiar or social,—the private,—and the domestic or economic; all being alike severed and connected by means of halls, vestibules, courts, corridors, passages, and staircases, and so that every apartment may be at once secluded and accessible, and without destroying the power of secluding or of making accessible every other whose use demands one or both of these qualities.

The economical composition of a building, with reference to the materials to be employed, in drains, foundations, walls, partitions, floors, roofs, ceilings, stairs, doors, windows, chimnies, and all other essential and accessorial details, with the details of their construction and combination as to quantity and quality of material, and the proportion of each particular kind, and the nature, quality, and extent of work or labour required, or to be employed in constructing and combining the materials, is an important part of the study of the architect. The basis of this study—the arts of construction—I treat of in another course addressed to both architects and engineers, but in the practice of the architect the economical composition of materials involves the application of the arts of construction with a multiplicity of detail unknown in the ordinary practice of the engineer or hydraulic architect. There is not only the formation, construction, and fall of drains, but their ramified distribution to take off both water and soil drainage, and to make the water act upon the soil to scour it away; supplying water, too, sufficient to effect this from some certain source, trapping them in such manner as to cut off and prevent the return of offensive smells, arranging so as to render them easily accessible for repairs, and in arranging to avoid running them through the bases of the superstructions;—all form essential studies for the architect. In like manner with the various kinds of materials in parallel constructions, and having irregular or unequal tendencies to settle, as brick or stone walls and partitions, and partitions of timber,—brick walls and stone stairs set in them;—these, and numberless other things in the ordinary practice of the architect, call for the exercise of much forethought and consideration in the economical composition and combination of materials, where the unpractised observer would not discern a necessity for either, until the effects resulting from the want of both, and of sound practical knowledge to guide them, are displayed in bulged walls, cracked ceilings, rounded floors and doors, sashes and shutters that will not shut when opened, nor open when shut.

The particular arrangement and distribution of buildings according to the purposes for which they are respectively required or intended, to adapt every kind of building to its special use, demand that the architect be of ready apprehension, and that he possess ingenuity in devising, combined with skill in constructing; for practice will more frequently require him to make his plan to fit the place than supply a place to receive the building as he might prefer to plan it, and he will thus be called upon to invent arrangements in almost every particular case, to secure what is required in the manner best adapted to the circumstances of the case. The uses of buildings are, indeed, so various, and the requirements of each particular use so different from those of every other, in all the classes of buildings,—every individual building of a class requiring or possessing peculiarities in site or other circumstances, and thus presenting in every case a new study,—that an architect cannot stereotype the drawings and specification of a design for any particular class of building, though rendered as perfect as the most careful study with the most intimate knowledge of his subject can make it, any more than the lawyer can stereotype his brief, or the physician his prescription, unless, indeed, the architect be,—what the physician who did so would be called—a *quack*. Every case brings to the lawyer its own circumstances,—in which he finds it to differ from every other, though the name of the process be the same; the physician finds every new patient to present something different, though suffering from the same disease; and the architect finds the data upon which he has to work,—be the subject a church or a college,—a mansion or a cottage,—to differ for every church, college, mansion or cottage, to which his attention may be directed. The usual premises are the *subject*, the *site*, the *kind and the extent of accommodation required*, and *the money to be expended*. Instead of this last premiss, it would be more proper to give the kinds and qualities of materials to be adopted, and the quality of work required, as to finish and decoration, though it is too frequently expected that these shall be of the more, if not the most, expensive, while the outlay is limited, and the architect has, not only the task of adapting the subject to the site—frequently no easy task—but the further complex Procrustean operation involved in fulfilling the other conditions, which—it may not be wondered at—architects seldom succeed in doing perfectly. In the first place, and independently of site or other circumstances, and irrespective of cost, the various subjects present themselves to the architect with their varying general characteristics, and, as I have said, the consideration of these alone will show that the requirements of the classes of buildings are neither few nor easy of fulfilment, without perfect possession by the architect of all the technical knowledge and skill already indicated, and of science to guide and regulate the process; nor, indeed, with all these unless he have acquired habits of observation and possess ingenuity in the application of what he may know and observe, together with facility of invention and power of adaptation, even in the arrangement and distribution of buildings with reference to their uses only, and without any reference to decorative disposition, which last may be said to form almost a separate study.

Taking the various subjects or classes of buildings which form the common range of architectural practice, it will be seen how they justify these observations. And first as to Churches. This important class of buildings demands an arrangement which will give peculiar prominence to one person—the minister—who must be brought within the eye and ear of every individual of a congregation, and enable the congregation to unite with the minister in public worship, and that without confusion from imperfect means of communication; whilst, at the same time, the largest number of persons must be brought within the smallest space consistently with the comfortable accommodation, in the varying attitudes of sitting, standing, and kneeling, of every person provided for; together with freedom and ease of access and egress to and from every part with the least possible display. In Courts, Halls, or Chambers for Deliberative Assemblies, it is required that every individual congregated shall be alike visibly and audibly prominent. Courts of Law, and for the administration of justice, demand prominence to be given to particular persons, as the judge or the magistrate, the accuser and the accused or their counsel, the witnesses and the jury, and so that each and every one may see and be seen, hear and be heard by all the rest; whilst a continually changing auditory must be provided for, and in such manner that the movements of unoccupied persons may not disturb or derange the business of the tribunal. Town and Guild Halls combine many of the requisites of both chambers for deliberative assemblies and courts for the administration of justice, on a smaller scale, but their compound character demands for them, nevertheless, a particular study. Theatres, as usually understood, for the exhibition of dramatic performances, require the perfect exposition for both sight and hearing of one part to the occupiers of all the rest of their interior, with separation of the occupiers or auditors amongst themselves into classes, and some of the classes again into secluded parties, giving to all classes separate means of ingress and egress, and at all times without disturbance or confusion. Other than dramatic theatres require their own particular objects to be provided for, and all but theatres for dramatic exhibition and performance require the admission and diffusion of the light of day as well as provision for artificial lighting, which latter alone is supplied to dramatic theatres, and constitutes them singular in that important particular. Exchanges, or *Markets without the presence of the commodities to be bought and sold*, require accommodation for large concourses, and in such manner that people may move about singly or in groups, and thus intercommunicate without confusion. Markets, *for the exposure and sale and purchase of goods*. These are real and substantial Exchanges, and they may be general or special, and according as the market is devoted to one particular purpose,—when the arrangements must be specially adapted to the conservation of the particular article, as well as to its exposition for sale,—or the market being general, it must possess in different parts the peculiarities necessary for different articles;—whilst, in all, every facility is to be provided for freedom and ease of passage to the public in every direction, and all convenience of exposition for sale must be made subservient to facilitate the examination and selection of articles by buyers. Baths, though not so much called for, indeed, in this country, as public establishments, as they may and ought to be, require much skill and tact to arrange and distribute them without loss of space, and to effect the separation and seclusion of one part from another, and to provide for the combined publicity and privacy which the use of swimming-baths—the best sort of bath—compels and demands. It would, however, be endless to rehearse in detail the requirements of every particular class of buildings, and the recital of their designations will convey a sufficient idea, for my present purpose, of their varieties, and of the demand made therefrom upon the architect for ready apprehension of the peculiar requirements of each particular class of buildings, and for intelligence and ingenuity in supplying and producing what may be required. There are buildings for fiscal and administrative purposes in almost endless varieties:—Public,—as Custom Houses, Excise Offices, Mints, Stamp Offices, Post Offices, Offices and chambers for the departments of State, Treasury administration, administration of the army and navy;—combination of public and private,—as the buildings of the Bank of England, and the East India and South Sea Houses in London, ordinary banking-houses, offices of assurance, and other companies administering business in public and with the public. COLLEGIATE AND UNIVERSITY BUILDINGS have certain general requirements in common, but these are few compared with the diversities that occur in them according to local, social, and other circumstances, so that arrangements admirably adapted in one case may be totally unfitted for, or unsuited in, another. Suppose the buildings of any college at Oxford or Cambridge,—suppose those of King's College at the latter university,—to have been selected as models for the buildings of King's College in London; it will be obvious at a glance, that when the site of the latter is determined to be part of that of Somerset Place, the models are of no more use in this case than a model of Somerset House, with its deep substructions, would be for a Royal Palace upon the high and open platform of Hyde Park. The combined school and hospital, as at Christ Church in London, must require buildings widely different from a proprietary college school, and so on through every variety, from the splendid collegiate buildings at Eton to the humble parish school. MUSEUMS OR CONSERVATORIES for the safe keeping and preservation and convenient exposition of various objects, demand peculiar treatment in their arrangement and distribution to fulfil the different and differing conditions,—for exposure and preservation are with many things almost incompatible with one another. EXHIBITION ROOMS and GALLERIES, whether for works of art or for productions of industry, must be arranged to suit their peculiar ends, and with direct reference to them. There is room—very great room—for improvement in the arrangement of this class of buildings, for too frequently light is admitted in such manner as to throw heavy shadows over the objects intended to be displayed, or the objects are rendered invisible by the manner in which the light is made to fall upon them, or again, the objects being placed behind or under glass, the observer finds a reflection of himself or of the skylight frames, or other apparatus by which light is admitted, instead of the picture, preparation, or specimen, which it is his object to see. It may almost be considered waste of time for a young architect to occupy himself in studying the arrangement and distribution necessary to a ROYAL PALACE, as it may be quite time enough for such a matter when the occasion shall occur, but such buildings as Royal Palaces have been wanted, and the architect has been found wanting. Moreover, buildings for combined state and service, partaking of the nature of palaces, though not royal residences, are not so unfrequently required, so that the study of even that class of buildings may not be thrown away. HOSPITALS for the sick in body, and ASYLUMS for the diseased in mind—PRISONS for the accused, and PENITENTIARIES for the convicted—BARRACKS for soldiers and ARMOURIES and ARSENALS for the preparation and conservation of war-like stores—MILLS and MANUFACTORIES, suited to the thousand arts of industry—STOREHOUSES for receiving and laying up the raw material, and WAREHOUSES for the reception of the manufactured goods—SHOPS and SALE-ROOMS for the display and distribution of the various articles in a condition for use—all have their peculiarities and every peculiarity in each particular case is to be learnt and applied, so that the brewer may find that the architect can improve upon the arrangements he had deemed perfect in his brewery, and the surgeon confess that the operating theatre of his hospital is better adapted to its purpose than he had imagined possible. The largest class of buildings yet remains, and it will be found that great as the variety of requirement is in buildings distinguished as public, it is even greater in the class of DWELLING HOUSES; for although every house may be resolved into the three departments which the uses and habits of social life require.—every house having its sitting room, its sleeping room, and its cooking room,—the nobleman's mansion must have these multiplied and extended, with accessories to include all that human wants and wishes can demand, whilst the shopkeeper is content to expose his goods for sale in the best parts of his house, and to cook, eat, and sleep where his business may leave him room, and the labourer in his turn is but too glad to find his cottage so arranged by the economic skill of the architect, that cooking, eating, and sleeping, have each a separate apartment. The idea of a peasant's cottage being included in the studies of an architect may excite a smile, but if architects were more employed upon peasant's cottages, there might be less occasion for their services in building County Hospitals and Union Workhouses. With the class of dwelling-houses may be included the study of buildings which often become accessories to the dwelling-house, as stables to the mansion, and agricultural buildings to the farm-house, though, indeed, both have their peculiarities, and require much observation and careful consideration to adapt properly to their uses. Inns, hotels, club-houses, public libraries, and buildings for the use of societies or institutions for the promotion or acquisition of knowledge, with their museums, their theatres or lecture rooms, and their reading rooms, possess a mixed public and private character, and must be treated accordingly.

I include, in the course of study for the architect—to make the course of architecture complete—the particular design, arrangement and distribution of works of hydraulic architecture; for the separation of this into another branch of practice, induced in great measure by a cause to which I shall refer, has left the architect ignorant of much that he ought to know, whilst the engineer has not learnt what architecture in its complete form would teach him. There is, indeed, one class of works in particular, usually undertaken by the engineer, susceptible of being greatly improved and greatly economized, but it is through an alteration in the stereotyped arrangement which long usage has sanctioned, and the engineer-architect is not architect enough to discover the fitness of the innovation, and architects have been such slaves to a stereotyped system of architectural disposition that they would not venture upon, if they had discovered it. I allude to bridges of masonry, of which the design may, I believe, be greatly improved, while the cost of construction is materially diminished.

The *firmness* and *commodity* of buildings being provided for, the decorative disposition, or the condition that Sir Henry Wotton distinguishes by the term *delight*, is to be considered; not that the consideration to this end is to be deferred or postponed, for if it be not present to the mind of the architect in designing for firmness and commodity—if every arrangement for strength and convenience be not harmoniously disposed and fittingly proportioned—*delight* will never be found in his work, though it be hedged in with columns, or fretted with pinnacles. It matters not what the style may be; whether the leading lines have an horizontal or a vertical tendency, the elements of beauty are the same. An Egyptian obelisk, a Grecian temple, a Roman aqueduct, a Gothic castle, and a pointed cathedral, all speak to the same effect in their different languages in this respect.

In referring to the various recognised forms, modes, and styles of design, I am necessarily called to a re-consideration of the views and opinions to which I have been publicly committed for more than ten years past, and this the more especially, as they differed from the commonly received doctrines as to authority and example in these matters; and as I have, as I believe, by means of the publication to which I allude, influenced the opinions of many of my juniors in the profession, whilst the appointment which I have the honour to hold in this college renders it probable that the effect of my opinions will have yet a still further influence upon those who may be and become students of architecture here. I have met the accustomed fate of innovators, having been misrepresented by garbled extracts from what I have said, in one quarter,—and my suggestions and illustrations have been adopted, exemplified, and put forth as his own, by another writer, who intimates in the same volume, that I shall retract my opinions when I have grown old enough to know better. The name that I was the first to suggest for the beautiful style of architecture of which we may be proud to possess the finest exemplars and the best school in practice, has been adopted and employed by many, but never, as far as my observation has reached, with the slightest acknowledgment of the source from which they derived it.

I can perceive, in what I wrote between ten and twelve years ago, many remarks that more practical knowledge, derived from longer experience, and a more matured judgment, the gift of added years, would enable me to improve in revising; but I do not find anything to retract in the opinions I expressed, or in the advice I offered. I make this statement after having again looked carefully through the writings of Vitruvius, in the English version of one of his best-qualified translators that I might not have to guess, with one of his most ardent admirers and devotees, at his Greek as at his Latin, and thereby come to a worse conclusion. I find now, as I found before, much fabulous narrative, many unintelligible or inapplicable descriptions and directions, some truisms upon the art of building, some curious antiquarian reminiscences, and some excellent remarks upon professional conduct and practice; and I continue, thereupon, to hold the opinion that I formed before I was twenty-five years of age, and published before I was thirty, and now repeat to you, that "a student would acquire as correct a knowledge of history and of geography from the 'Seven Champions of Christendom' and 'Gulliver's Travels,' as of architecture from the existing writings of Vitruvius."

My own treatise upon architecture will be my text-book in treating of the various modes and styles of design, and of their application in practice; but I shall prefer to illustrate my observations by reference to works in execution to any other mode, believing that I may thereby induce a habit of observation in the student, which will be of much greater value to him in the formation of his mind and in directing its application, than can ever be obtained by the in-door study of drawings and models, or by the attempt to originate and design before the mind is formed and before the judgment can be matured.

The various forms, modes, and styles of design usually recognized in architecture are generally conned by the student in drawings, and learnt by rote in copying; and the details thus acquired are often applied in practice, without a thought or an idea on the part of the practitioner that architecture consists in anything more than a repetition of those certain forms, disposed according to certain fixed rules. In truth, however, each particular style may be considered as a distinct and peculiar language; and, like a language, before a man can compose in it, he must not only learn to read and to speak it, but to think in it; and more than that, his mind must be fully imbued with the genius and spirit of the language, before his compositions in it can be rendered deserving of admiration, even when the power of original thought is present. It is not all men that can speak and write, who can speak and write *well* even in their mother tongue; they are few who can compose with ease and elegance in another than their native language; but where is the man to be found, competent to compose and to express himself with propriety in each language of all the languages that possess a literature? And where is the architect who can use with truth and freedom all the various styles of architecture? Rather learn to use one style well than many styles badly, or your Greek will be like the nonsense verses of school-boys, and your English or Pointed compositions like the English of modern novelists, larded with scraps from all the languages spoken under the sun, and alike offensive to the mere English reader, and to the judicious and tasteful admirer of all literate language, when used with propriety, with proper knowledge of their powers, and with sufficient power to wield them.

From what I have already said, it will I think appear sufficiently obvious that the qualifications of an architect are neither few nor trivial; and that when acquired, they place him as much beyond the mere artist, as the artist is beyond the artisan. Architecture and architects suffer together, from their association in the public mind with the imitative arts, and with mere artists:—the practice of architecture is thought to consist in making drawings, and the architect to be at best but a drawer of plans! Hence the responsible duties that devolve upon the architect are quite lost sight of; the careful study required to fulfil the conditions necessary to building well—the labour of pre-arranging and specifying everything for useful service, and as to labour and materials, their proportion, composition, and combination, in detail, so that the cost of execution may be minutely estimated beforehand—the anxious care in supervising, that the work be properly executed, preparing and supplying in the meanwhile perfect delineations of the constructions and decorations in detail, and the eventual investigation of accounts;—all these things are unknown, overlooked, or unheeded, and the architect is considered as an overpaid artist—artists being linked in the same category with players, fiddlers, and dancers!

But why, it may be asked, is this so? Why are men who must have extensive scientific and artistic qualifications—who must, moreover, be good men of business, when they are properly qualified to practise as architects—and who must, withal, be in a certain condition of life, to be trusted with directing the expenditure of large sums of money—why is it that this class of men is so lightly esteemed? I have already said, that it is in a great measure because architects have sunk into *mere* artists: as such they are considered, and they submit thereupon to be treated in a manner that would be resented as insulting by any well-regulated profession. An architectural design is looked upon as an artist's sketch—a work of nought,—and every man, how ignorant soever, deems himself competent to judge of its merits; and the unworthy practice of architects is to submit to have their productions so considered and so adjudged. Consequently architecture, as at present practised, is not a profession for a gentleman; but it is in the hands of architects themselves to amend the practice, and if every young man entering the profession would determine for himself that it should be amended in his case—as it has for a long time been in mine—a very few years would suffice to render the profession of architecture as honourable as it is useful.

I shall have been understood to refer to the existing practice of making designs, by what is termed competition. Now competition, properly conducted, is the sure way to obtain excellence; but there are many conditions to the proper conduct of a competition. There must be perfect explicitness in the terms,—careful investigation to determine that the terms are complied with,—perfect competence in the judges to select,—and perfect honour in making the selection. But to be what they ought to be, the terms of a competition should go to the extremest degree of minuteness, and amount to an unapplied specification; every design should be accompanied by a specification of the terms applied by the author to his particular design; and every design, with its specification, should be tried by competent and trustworthy investigators, upon the specified terms. Such of the designs presented in a competition as should pass such an examination might be then examined as to their fulfilment of the conditions in *building well*, and with special reference to the existing case, and the selection made accordingly.

But where are the parties requiring designs for works of architecture who will incur the expense, and take the trouble to propose terms as they ought to be proposed, while architects will speculate upon the chances of interest, or upon the effect of a clap-trap drawing or model? where the architect who would take pains to act up to the terms—if the conditions were as I have supposed—for a mere lottery-like chance of being either re-imbursed his expenses, or paid for his labours? and where the tribunal to which designs for works of architecture could be submitted, with the remotest probability of their being examined, understood, and appreciated, in such a manner as to insure the selection of the best design? Such a tribunal is not to be found, and such an one cannot exist under the present system; and all the schemes hitherto propounded, as far as my knowledge goes—and I have not been a blind observer—are utterly inadequate to answer the true end of competition—the production of excellence.

Some would form a jury of architects, to investigate the merits of designs submitted in competitions; but the favourite project is to exhibit competition designs, that the *public* may judge of their merits. Exhibit Greek odes, and hieroglyphic inscriptions, and ask the public to judge of the merits of the one, and to give translations of the other! for there are as many of the public as competent to either of these things, as to judge of the comparative merits of a series of different architectural designs for the same thing:—I mean, of course, with reference to all and everything that a design should include. It seems strange, too, upon reflection, to find that in every proposition it is the architects who are to bear the expense of any proposed investigation! But who are the parties to be benefited by a competition? Surely, not the architects! Only one can have the commission contended for, and the most likely man, if there were to be no competition, is the most certain when there is one; neither is the amount of business for the profession, nor the remuneration of the successful competitor increased, by the establishment of a general concurrence. How then is it to be managed, that the public shall have the advantage of competition to obtain pre-eminent designs, whilst architects may not be degraded by submission to insult and injury? Simply thus; that architects should do as,—or rather, should not do otherwise than,—lawyers and physicians do. What barrister takes a brief, or what physician visits a patient, without an *honorarium?* Who ever saw an advertisement from a town council or a corporation committee, addressed "To Barristers," asking an opinion upon a legal case in which they might happen to be interested, intimating that a copy of the case would be supplied to competitors by the town-clerk, on payment of a guinea, and that the party whose opinion the aldermen or the committee-men might think the best should have a premium of ten guineas, and perhaps be employed to conduct the case? Or who ever heard of a sick man sending for half a dozen physicians, with an offer of a guinea to that one of them whose advice he—the patient—might think the best? And why should it be otherwise with architects than with barristers and physicians?—The only way to establish and maintain "respectability and uniformity of practice" in ungoverned professions is, (by mutual consent, which a minority in standing and reputation must yield, if a majority require it.) to hold no brief,—to give no advice,—to furnish no design,—without a competent fee. It is the parties seeking designs, and who desire to derive advantage from the application of many minds to the same subject, that are to be benefited; and they who seek a benefit must be content to pay for it. Moreover, it can never happen, but that in several designs for the same thing there will be some points or parts in some or other of the designs, than that which may be generally the best, better than the same parts in the best design. When all are paid for, all may be used; and the best design in a concurrence may be greatly improved by the incorporation of the excellencies of the others.

Had the course I recommend been pursued in the case of the Houses of Parliament Designs, the eminent architect who was most deservedly successful in that competition must have been included in any number called upon, however limited, because of his already attained eminence, and the country would thus have had the advantage of such improvements in the preferred design as the other concurring designs might have suggested; and this without submitting the architect himself to the insults he received in being charged with pirating un-premiated designs. Reference to this calls to my recollection an instance in connexion with it of the disadvantages architects suffer, from the habit the public, and with the public the public authorities, have acquired of considering architects as mere artists. The architect of the palace of the Legislature was put into leading-strings during the formation of the foundations of his work; and the construction of the river-wall, which forms the effective basement of its main front, was taken entirely out of his hands!

Again, it is essential to the proper understanding of an elaborate design in architecture, that the architect should explain his intentions, with the drawings before them, to the parties who may have the selection. This being done by the four, six or eight architects who may have been called upon,—for where fees are to be paid to all concurring, there would be no advertisement, such as I have often seen, giving permission to, rather than inviting a concurrence of, "*masons, builders, surveyors, and architects!*"—unpractised persons would be able to determine, without great risk of error, upon the design best adapted for what they may want. Favour may determine the selection, certainly, but that is the case now, and to a much greater extent than could be when the more intelligent man was seen in connexion with the better design; and besides this, the uncommissioned competitors would, according to my proposition, be paid for their trouble, and would receive no substantive injury by the wrong the parties might thus do themselves, or those for whom they act, in selecting by favour rather than by merit.

The general competition system has been defended upon the plea that it gives young men opportunities, or chances rather, of obtaining employment that they could not otherwise hope for; but I believe that the moral injury done by the system to young men, in leading them to bow and cringe in seeking favour, and from the unworthy too, and the expenses they may be drawn into, are evils but poorly compensated by the advantages, such as they are. Young men have been ruined for life by success in a general competition; some have been cheated out of the prizes they were declared to have won; and many have been driven to despair by failure, who might in due time have succeeded in obtaining business, had they worked duly, and had they not been tempted out of the beaten path of industry by these *ignes fatui*. Another plea is, that competition designs give architects employment for their pupils. This must, of course, be in the absence of practice; and I introduce this subject here, to take from it the opportunity it affords, of warning students against offices where the usual occupation of pupils is in making speculation designs. You may do such things, if they ought to be done, without paying high premiums for the privilege of doing them in an architect's office.

To make the profession of architecture worthy of a gentleman, you must determine, each man for himself, that it shall be so; and to this effect decline to render professional services in any form, without that species of acknowledgment which it is essential you should obtain, to secure respect for either your services or yourselves.

The Artesian Well at Grenelle.—A new tube is now making for the well of Grenelle in iron, of such a thickness that it will bear the pressure of 50 to 60 atmospheres. Experiments have been tried on two tubes placed one within the other, as the tubes were in the bore of the well, to ascertain what degree of pressure would be necessary to force them in; but though the hydraulic ram was employed, it required a pressure of from 12 to 15 atmospheres to produce any effect on the tubes. The water still flows as copiously as ever, moderately warm, and alternately limpid and black as the sewers of Paris.—*Galignani's Messenger.*

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.

(Continued from page 60.)

LECTURE VII. Jan. 5, 1842.—The Professor commenced by stating that he had then reached the third division of the first course, and his present lecture would be upon retaining walls. The meaning of the technical terms of "retaining" and "sustaining" walls was—when a wall was used either to support water or earth artificially put together; but when it was used to support natural earth, it was often called a "breast-work." As the term "batir" would often be made use of in that and the following lecture, he proceeded to explain that the batir was the base of a triangle, formed by the slope of the wall and perpendiculars of the other two sides—thus a batiring wall was a sloping wall. The introduction of retaining walls was very ancient; in Italy there were several of great antiquity, formed of concrete, rubble, &c., and even some parts of the great wall of China were built in that way. Retaining walls were generally introduced at the ends of bridges, to connect the abutments of the bridge with the natural ground; but in these cases they were called "wing walls." In forming roads retaining walls were sometimes carried along the sides of the valleys—the road itself having to be cut at times along the sides of hills so precipitous, that half was embankment and half cutting. In the celebrated road formed by Napoleon across the Alps, there were many instances of work of this kind, and good lessons could be learnt from the failures which had taken place, the reasons for which were generally very apparent. In Telford's grand road through Wales, there were many instances of retaining walls, and one in particular, where the road had to pass along the side of a hill which was nearly perpendicular. The great cutting from Camden-town to Euston-square was another instance, but, from certain causes, which he very ably explained, the walls were giving way in many places. He then proceeded to lay down, by numerous diagrams, seven forms of retaining walls made use of, and pointed out, by mathematical formula and practical experiments that had been made, and which the diagrams explained, the best forms for use. In No. 1 the batir was represented as being equal on each side of the wall; in No. 2 the batir was on the side next the earth to be supported; No. 3 was a parallel batiring wall; in No. 4 the batir was next the earth, but at the bottom of the wall, No. 5, the batir was on the outside, at the top; No. 6 was a parallel and perpendicular wall, with no batir on either side; and No. 7 had the batir at the outer side of the wall, and next the earth the slope was cut in steps; these seven diagrams showed the common forms of retaining walls. The grand points to be considered were—1st, the value of the pressure that the earth exercised against retaining walls; and, 2nd, the description and dimension of the wall necessary to offer sufficient resistance to that pressure. It was found that if you take away the wall, the earth will for a short space of time retain its position, but, after exposure, it will begin with crumbling at the edges, and ultimately gain a slope so as to lie at the angle, which is called the "angle of repose." This requires, in building retaining walls, that the angle of repose of the description of earth to be supported should be ascertained; this done, the pressure to be resisted might be calculated, and the dimensions of the wall be decided upon accordingly. Of all the descriptions of retaining walls, No. 3 was the one which offered the most support with the least quantity of material, and which had, by experiments made at Dublin, under the direction of Sir J. Burgoyne and the Board of Public Works of Ireland, been fully proved. The Professor then explained the nature of the several experiments, and the effects upon the walls, exemplifying them by very instructive diagrams. The attention of the students was next called to the curvilinear batir, and several very interesting cases were adduced of failure in that plan, from various causes, but principally from water. He then alluded to two or three failures of his own, and fully explained to the students the causes of them, and the means he should have adopted in the first instance for their prevention. The occasional supporting of walls was judicious in various instances; suppose there was a case, that, while the earth was in an unsettled state, the pressure against the wall was double what it would be when it had settled; in such a case he would recommend supporting walls until the settlement took place—not to go to double the expense for a temporary purpose. He then mentioned a very remarkable instance of an abutment, which was practically a retaining wall, giving way. He had to make an arch of twenty feet span for a river, through an embankment eighty feet high; the foundation was rock, but a sudden lurch took place in the body of the embankment, and the earth forced its way through very many feet of sand backing, drove the abutment or retaining wall clean off the rock, and moved the whole twelve or thirteen feet. Several good rules were then laid down to calculate the description of wall to be used, and method of giving a temporary support until the earth settled; and the learned lecturer, in conclusion, stated that his next lecture would be given on Wormwood Scrubbs, where there were some most remarkable instances of failures in retaining walls, the reason of which he could better explain on the spot than by diagrams.

THE ATMOSPHERIC RAILWAY.

LECTURE VIII. Jan. 10, 1842.—This being intended as a practical illustration of some interesting and important points, the lecture was delivered on the works of the railways situated at, or near, Wormwood Scrubbs, in place of being given, as usual, in the lecture room of University College.

The first point to which Mr. Vignoles directed the attention of the class was to the atmospheric railway, or rather, a portion of railway laid down on that principle for experimental purposes, upon the line belonging to the West London Railway Company. The length of this experimental line is half a mile, and, according to the Professor's statement, it fully answered the purpose; and he, at some length and with great ingenuity, explained the principles of the system. The iron tube first attracted attention; it is nine inches in diameter, with a grooved slit along the upper surface, which is closed by means of a valve of leather, strengthened by plates of iron, flat on the outside, and forming the segment of a circle on the inside, so as to complete the diameter of the tube when it is shut; at the edge of the valve is a composition of bees'-wax and tallow, which renders the tube air tight. Next was examined the carriage, to which was attached a piston, fitting into the tube, and a very ingenious contrivance was shown, by which the valve was first opened, and afterwards closed down, immediately after the piston had passed, however great the velocity of the carriage. The impossibility of procuring a perfect vacuum had long been assigned as the great objection to this principle of producing locomotion; but Professor Vignoles showed that a good working half vacuum was, by the simple contrivance he had explained, quite attainable, and sufficient for practical purposes. The engine and air-pump were next severally examined and explained, and the lecturer then gave some very interesting explanations of matters connected with the present experimental railway; he stated that the air from the half mile of tube could be extracted in about one minute, while it would take nearly eight minutes for the leakage of the valve and air-tube to admit the air to fill the tube. In consequence of the imperfections in the present line, which had been merely laid down for experiment, the leakage was very much more considerable than when a perfect line should be formed for service; and the formation of a railway on the atmospheric principle would not exceed, perhaps, one-third of the cost of many of the great lines hitherto contracted for, as it would do away with much of the cutting and embankment, the slips of which had recently been so troublesome and dangerous, by the trains being able, on this method, to ascend considerable acclivities. The present experimental line had a rise of about one foot in 110, and he had gone along at the rate of forty-five miles an hour, notwithstanding the imperfections of the machinery and the wretched state of the line. He pointed out that it would be practicably impossible for a locomotive to travel upon such a line, as it would be off the rails immediately, in consequence of their being so uneven and loose; yet he had travelled at the rate he before mentioned, with perfect ease and safety, and, furthermore, the extreme simplicity of the machinery rendered it very unlikely to get out of order. A few weeks back the line was required suddenly for some experiment, and, although the tube was half full of ice, in less than half an hour everything was in readiness, and the trial was very satisfactory. The power obtained by the present small tube is 500 lb., with an atmospheric pressure of about 8 lb. per inch only. The engine employed to work the air-pump is sixteen or eighteen horse-power, and the economy of stationary over locomotive power was admitted by every body. He concluded his remarks upon this interesting, and what promises to be most useful application of the power of atmospheric pressure, by detailing, at some length, the minutiæ of the saving that would be effected by its general adoption, and stating that two miles were to be laid down upon the Dublin and Kingstown Railway, to try the experiment upon a larger scale, with a tube fifteen inches in diameter, and more perfect apparatus. The Professor then, as the party walked along the line, pointed out to the class various slips that had taken place, some of which were slight and others extensive; one part in particular, situated between the Great Western and London and Birmingham Railways (which are here within a quarter of a mile of each other), attracted general attention, the whole, for nearly 100 yards, being a perfect chaos. A remarkable instance of a failure of a retaining wall here presented itself, it having for about forty-five yards, been actually pushed forward off the foundation, to a distance of eight or ten feet, the wall still standing, which appeared to be about four feet thick, strongly built of brick and concrete, and strengthened with bands of iron and wood. The causes of this destruction were explained by Mr. Vignoles as arising from the lodgment of water, which, having no outlet, had settled the earth against the back of the retaining wall, turning the clay into mud, and, by the great additional weight, forcing it into the position in which it now appears. If the water had been cut off in time this would not have happened, and that water was the occasion of this accident seemed very apparent. The lecturer then pointed out the manner of supporting retaining walls. Several portions of the London and Birmingham and

Great Western Railways were then examined, and much valuable information was given on the various contrivances made use of by these companies, and he concluded by appointing the class to meet on the Croydon and Brighton Railways the next morning, to proceed to the great slip near New Cross.

"THE SLIP" ON THE CROYDON RAILWAY.

Lecture IX. Jan. 11. 1842.—According to appointment, this Lecture was delivered at the great slip near New Cross, on the Croydon and Brighton Railways. The motive of this visit was to explain to the class the reason of, and to point out the means which might have been taken to have prevented, the great slip which occurred there recently. On leaving the train, the Professor led the way to the spot, which is situated about half a mile from New Cross. The length of the slip is very considerable. the depth of the cutting very great, and the mass of earth that has slipped down from the top of the bank is of an imposing appearance. The appearance of the slip is as usual—perpendicular at the top for some depth, and then bulging out near the centre; a great number of labourers are employed in shifting the immense quantity of earth to be removed, in consequence of the slip, which is estimated at many thousands of yards. In the meantime, a convenient covered walk has been made for the passengers to pass from one train to another. On both sides of this cutting, for some distance along the line, slips have taken place. but on the left-hand side going from London, they are of but little importance, compared with the one that was to be particularly inspected by the class. The soil consists of the plastic clay, with numerous strata of sand and gravel, the clay itself being very binding, but being, from the recurrence of these strata of sand and gravel, very liable to the infiltration of water; and, consequently, to slip, when the up-drainage is not particularly attended to, and the most constant attention paid to every symptom of a slip being about to take place. The Professor then pointed out what he considered to have been the occasion of all the mischief. Nearly all along the slip the earth had given way at the side of a top drain, parallel with the railway, and in some places it was so apparent, that the declivity looked as if made purposely; this had invariably occurred where there were cross drains from the neighbouring ground (which is considerably elevated), leading into the main drain along the top of the cutting, and which. not being puddled, or made watertight, had allowed the water gradually, and during many months, to insinuate itself into the veins in the clay, and had at length forced the mass out as it appeared. He then stated, as his firm opinion, that the slip ought never to have taken place: the earth having stood for three years, was a sufficient proof that the slope was correctly laid out; and, finally, it could only have been by subsequent natural causes that the accident occurred, while, if the precaution of preventing the drainage from the upper fields getting into the body of the slope had been attended to in time, it might have prevented the slip, and it was obvious that the great evil—water—had been gradually insinuating itself into the bank a long time before. In another part of the cutting, he pointed out a place where a slip was expected to take place in the slope; but he disapproved of what had been done by way of precaution, and explained that any operation of making cuts or vertical holes in the slopes, which would admit water, ought to be avoided by all means in the engineer's power, instead of being encouraged. The apertures should be driven in horizontally, and brushwood drains introduced. or a kind of hurdle or *fascines*, which would act as a drain, and be extremely efficacious; on this principle he strongly objected to the cutting of slight surface drains on the slopes, as he thought them worse than useless, being more likely to admit the water than to drain it off. He alluded to a curious circumstance which had occurred a little higher up the line, where the railroad was made in what used to be the bed of the canal. It appeared that there was a spring, and the water, instead of finding its way out of the slopes, actually raised up the rails. Several other points of interest were then examined.

Lecture X.—Wednesday, the 19th Jan., Professor Vignoles delivered his tenth lecture "On Civil Engineering," on the West London Railway, at Wormwood Scrubbs. This was rather a practical illustration, by way of experiment, than a lecture—it being a practical exemplification of the working of the system of locomotion by means of atmospheric pressure, effected by the peculiar valve invented by Messrs. Clegg and Samuda. In addition to the ordinary class, which was fully attended, there was a large assemblage of scientific men, including several of the engineers of the Belgian railways, and officers of the corps of Royal Engineers; Mr. James Pim, and many of the principal proprietors of the Dublin and Kingstown Railway; Col. Jones, Col. Alderson, Major Matson, Mr. Woodhouse, Capt. W. Moorsom, and several other engineers.

SECOND COURSE.

On Wednesday, the 9th Feb., Professor Vignoles delivered his Introductory Lecture to the second course of lectures. He stated that, having in his first course of lectures touched upon several of what he might call the cardinal points of civil engineering, he was then about to enter the second course, for which (according to previously concerted arrangements) one only of the numerous branches of this profession had been selected as the theme, with a view of entering considerably into its details, rather than to discuss in a more general manner a variety of subjects, which, though perhaps equally important, equally interesting and useful, and equally necessary for the student, could not be thoroughly investigated in the course of a single session. In this introductory lecture he would, however, touch concisely on the wide topic of the internal communications of civilized countries, as falling within the scope of the theories and practice of a civil engineer, treating them here as on a general theme; but the subsequent discourses to the class would consist of the details of that more modern branch of internal communication, of so much interest in the present day—the Railway system. It had been well and truly remarked by an enlightened observer, that the great characteristic feature of the present age was the appreciation of the value of time. In an eloquent introduction to a pamphlet on one branch of internal communication, the author expressed himself in terms which he was tempted to quote, as an appropriate preliminary to his own remarks:—"In that career of improvement which has distinguished the last thirty years beyond, perhaps, any previous history of the world, and in which the sum of the vast ameliorations effected. in all that relates to the condition of man, is not less striking than the rapidity with which their details have followed upon each other; one important lesson seems to have been in an especial degree impressed upon those engaged in the pursuits of industry, and upon the commercial and manufacturing classes in particular—they have been effectually taught to appreciate the value of time, and to apply to its use a degree of rigid and judicious economy, of which the past affords no example; a lesson which is daily illustrated by the vast expenditure, in this country, upon works affording facilities in accelerating intercourse, since it is universally felt that distances are virtually shortened in the precise ratio in which the time occupied in travelling them is abridged." And it is the practical application of this axiom, which it is almost peculiarly the lot of the civil engineer to be called on by the statesman and the capitalist to realise. In looking back through the vista of centuries, and endeavouring to pierce the mist of tradition, we are led to conclude that the formation of roads must have been amongst the earliest rudiments of civilization; but until science, or, at least, until system, was applied to their construction, it is evident (from the traces of the simple paths of comparatively modern times, and of no remote countries) that the merest tracks sufficed to satisfy our ancestors, who had not yet learned the "value of time." Little more was then required than a path upon naturally firm earth—all marshy grounds were avoided—the fords of the rivers were alone resorted to—and the irregularities of surface, or inclination of the road, or its circuitous course, were of little consequence to the pedestrian, or even to the mounted traveller, when man had learned to subdue the horse to his wants and wishes. The path generally traced from one distant wig-wam to another became the track from village to village, and at length served as the road from town to town, or even to the capital. The line once traced out, indolence and habit seem to have prevented any great exertion to improve or repair, beyond what was indispensably necessary, even after the invention of wheeled carriages; and the system of following the ancient course of roads seems to have been pertinaciously adhered to in all countries until the advance of civilization, and the wants of the community, produced improvement, and gave rise to the calling of the road-maker, and ultimately to the profession of the engineer. The first exercise of his art—for it did not reach the dignity of a science until within very modern times—was, probably, in the formation of raised roads, or causeways, to strong holds, dwellings, or cities, accidentally or artificially made liable to inundations; and of this kind were the approaches to the passage of the River of Babylon, which the fables of antiquity magnified into a bridge, as long, and consisting of as many arches, as that in the celebrated vision of the Arabian sage. The first step towards internal communications being roads, it may be well defined as the first step in true civilization, and the Abbé Reynal has justly remarked—"Let us travel over all the countries of the earth, and wherever we shall find no facility of trading from a city to a town, and from a village to a hamlet, we may pronounce the people to be barbarians, and we shall only be deceived respecting the degree of barbarism."

By this test we should probably be induced to judge of the Chinese, if their water communications did not, to a certain extent, supply the absolute want of anything like a road capable of passing a loaded wheeled carriage, even at the gates of Pekin. Of all the people in the world, perhaps the Romans took the most pains in forming their roads, and vast was the labour and expense bestowed to make them spacious, firm, solid, and smooth—roads, in fact, from two to even ten or twelve feet thick, formed of what we call in these days "concrete:" but, as regards the system of laying out, in the modern engineering sense, they do not appear to have had the slightest idea. Straightness of direction seems to have been their only character, and, with a lofty disdain of the effects of gravity, their grand military routes, excepting near Rome itself, were carried direct over hill and dale. Thirty roads, of an aggregate length of 50,000 miles, radiated from their magnificent capital, in Italy, to the furthest extremity of their almost boundless empire; they only served as internal communications, for keeping down, by their legions, the rebellious spirits of the Briton, the Hun, the Greek, or the Persian, who had, in succession, bowed to the Roman yoke—yet, as monuments of the highest degree of art and civilization of those ages, must they be admired by all, and may be usefully studied by the engineer of the present day—few of whose constructions, even the gigantic railway, will probably endure as some of the Roman roads have done—such as the Appian Way, for instance—through the long period of nearly 2,000 years. The number and extent of these roads, made by the first conquerors of Albion, through this island, have only been ascertained and appreciated since the publication of the magnificent maps of the Ordnance Survey by the corps of Royal Engineers, by those who have studied their beautiful and surprising accuracy, and their minute topographical details, which enable a curious inquirer to trace, by their remarkable straightness of course, these ancient routes, through woods and remote districts, and over wide ranges of hills, where their origin, even in tradition, is now forgotten, and where the long lane, grassed over and forsaken, from its steepness or seclusion, accurately laid down, in its true course, by the science of the present day, marks, at intervals, over whole counties, the former line of the stately march of the Roman soldier. But it remains to this day an unsolved problem in engineering, to discover by what means these roads were laid out in such perfect truth of direction, through the thick and trackless forests which then covered the whole island. It has been observed, that it is one of the most difficult points for a political economist to define, with any degree of certainty, the line of demarcation between public and private enterprize, in the execution of works of internal improvement. In a former lecture, he observed that it was undoubtedly owing to the establishment in France, by Richelieu, of the Board of Roads and Bridges, that that country was in possession of excellent roads long before the principal part of Europe; he might have added, also, canals—at least, before we had them in Great Britain, and yet have a good reason to believe that, at the present time, that very establishment is a serious obstacle in retarding the introduction into France of the modern system of improvement of internal communications, by paralysing the self-dependence of the districts. In this country, the very opposite system, of leaving almost everything to private enterprise and individual exertion, has been most strikingly successful, and has fostered and matured the talent, the ingenuity, the skill, and the experience of the civil engineer, from the competition created by the necessity of individual exertion, which it is presumed would not have been developed, had he been a Government dependant. The origin of the system of forming and repairing roads by trustees, and the collection of tolls for that purpose at turnpike gates, dates somewhat more than a century back, and the rapid improvement of our internal communications, both by land and water, about that time; and it is a remarkable fact, that, when land was of comparatively small value, it was more difficult to obtain ground for a new road than at present, when a square yard of land sometimes costs more than would have purchased a rood in former days; and when one of the public objections seriously urged was, that if so many roads and canals were made, it would diminish the quantity of land required for agricultural purposes! But, happily, general knowledge has been diffused, and the former prejudices have yielded to calculation, as man has acquired a knowledge of the value of time, and has found that the payment of turnpike tolls, for good and level roads, is cheaper than to keep extra horses to drag his teams up steep hills, or through marshy ruts. The Professor next stated, that he should not go into the detail, either of the laying out, or the construction of roads, but he must add a few observations, as connected with the duties of an engineer, in regard to some of the general principles. He should accommodate a new line of road to local circumstances, so far as could be without superseding public advantages. It would be ridiculous to follow the old Roman fashion, on the mathematical axiom, that a straight line is the shortest that can be drawn between two points. This would not make the most commodious road—hills must be avoided, towns must be resorted to, and the sudden bends of rivers must be shunned. It is not suggested that roads should be made serpentine, merely for the sake of the picturesque; but the skill of the engineer is to be exerted in avoiding irregularities of ground and irregularity of inclinations, and he will generally find, that a strict adherence to a straight line is of much less consequence than is usually supposed, even in actual distance over long lengths. It was well known that a blind man was, some years ago, advantageously employed through Yorkshire and Derbyshire, in laying out roads through those hilly counties. He followed the streams which made their way amongst the hills, and, by finding out the chords of such arcs, or bends of the river, as passed on practicable ground, he succeeded in his attempts. It is obvious that, when the arc described by a road going over a hill is greater than that described by going round it, the circuit is preferable; but it is not known to the ordinary road surveyor, though it ought to be ingrafted in the mind of the engineering student, that, within certain limits, it would be less laborious to go round the hill, though the circuit be much greater than that which would be made in crossing it. Thus, when a hill has an ascent of no more than one foot in thirty, the thirtieth part of the whole weight of the carriage of the load, and of the horses, must be lifted up, whilst they advance thirty feet. In doing this, one thirtieth part of the whole load continually resists the horses' draught; and thus, in drawing a waggon of six tons weight, a power to overcome resistance equal to the force of two additional horses must be exerted. But what is here said of level roads must not be strained into an assertion that a perfectly level road is always the best for every description of draught or load. Alternations of rising and level, or of falling ground, are serviceable to horses moving very swiftly; the horse has time to rest his lungs and different muscles, and of this the experienced driver knows how to take advantage; but while this qualification is made, care must be taken not to strain it too much, as did one provincial road maker, who very ingeniously carved a naturally quite level road into a series of short billowy undulations, which his successor had to level again. Without travelling through the whole history of road improvements, he might state that Telford in England and Scotland, and in Ireland, Nimmo, Griffiths, and Edgeworth, brought the laying out and construction of roads to the present perfection; and of the writings of the latter he had availed himself in many of the preceding observations. The many roads of Great Britain were just arrived at almost the highest degree of perfection, when again the increased appreciation of the value of time led speculators to conceive, and our engineers to realize, the idea of the employment of iron surfaces for roads. Before, however, following the gradual transit of roads into railways, he would make a few observations on the other branch of international communication—the navigable river and the canal.

The tastes and speculations of the last fifteen years have been so exclusively devoted to railways as the fashionable mode of internal communication, that canals have almost been lost sight of, and it is now nearly forgotten by the modern speculator, though it may be interesting to the young engineer to be informed, that fifty years ago the mania for constructing canals and improving river navigation was as great, even if not greater, than the enthusiasm displayed very recently about railways. Parliament was then deluged with applications to grant Acts of Incorporation for canal companies; the press teemed with canal publications, the shop windows were filled with canal maps and sections, and the papers and periodicals with advertisements and paragraphs on canalization. Canals appear to have been duly appreciated in ancient times, and used for the purpose of drainage, irrigation, supply of water, and navigation. In his former introductory lecture he alluded to the canal of Xerxes, at the foot of Mount Athos—an attempt which is stated to have been renewed by the Roman emperors in later ages. A canal navigable for large boats was constructed by the Ptolemies between the Nile and the Red Sea, though it is doubtful whether the state of engineering skill in those days permitted an actual junction to be made: this grand navigation was re-opened by the caliphs in the seventh century. Traces of it are still existing, and its termination in the most easterly branch of the Nile was discovered by M. Boutier, in 1707, and is still open. Under the enterprise of the present ruler of Egypt it may yet fall to the lot of an English engineer to re-open this magnificent canal. Herodotus assures us that the Nile was in itself, or by lateral canals, navigable by the ancient Egyptians for 500 miles above Alexandria, and the Delta of the Nile was formerly like modern Holland, filled with canals. The Romans made more than one canal in England; the most remarkable was that called the Caerdyke, which united the river Nene, a little below Peterborough, with the river Witham, three miles below Tiverton; it was forty miles long, and fifty years since appeared distinct enough, and must have been originally very deep; and what led to the impression that this canal was used for the purpose of internal communication, was that there was a continuation of this canal from Lincoln to the Trent above Gainsborough by the Foss Dyke, which is at the present time a fine navigable canal, though, in former times, it had been repeatedly filled up and gone into disuse. It is believed, on good authority, that by these two canals the favourite colony of the Romans at York received their chief supplies of grain. The canals of China have always excited great interest since the description given of them by the Jesuit missionaries; their accounts, as far as regards the Great Canal running from north to south (connecting, except at one short portage, Canton and Pekin), have been completely confirmed by modern travellers, particularly by Barrow, who travelled the whole length. Should the existence of the numerous lateral and other canals over the rest of the country be confirmed, of which there is little reason to doubt, it will sufficiently explain the non-existence of anything like good roads, and the almost total absence of wheeled carriages for goods, to which the diminutive and bad breed of horses in China, no doubt, contributes. There is, however, a wide field opening in that country for the exercise of the skill of an enterprising engineer, since that ingenious people are as yet ignorant of the modern lock for their canals, and when two canals meet, the difference of the level is sometimes from fifteen to twenty feet, and the boats are hoisted from the lower canal up an inclined plane of smooth masonry by capstans, and slide down another into the upper canal. The professor stated it would lead him too far to go much into the history of canals, but he must allude to the great canals and inland water communication of the Mogul country, in the East Indies, made by the Emperors 500 or 600 years since, for which the natural features and vast rivers of Hindostan afforded great facilities, and rendered lockage unnecessary, and, indeed, roads were unknown, and may be considered as still wanting all over India, excepting our recent military roads. This country presents a vast field for the civil engineer. Of all the canals of modern Europe he would only notice two remarkable instances; J. Perry, an English civil engineer, was employed by Peter the Great in the beginning of the last century to design and execute several canals, in which the German military engineer (Brockel) who had attempted them, had entirely failed; Perry's designs were subsequently completed by Peter's successors. The canal of Trolhatta, in Sweden, the difficulties of which had long baffled the engineers of that country, was finally completed by the skill of the late Mr. Telford, whose engineering resources were equally displayed in the design and execution of the Caledonian Canal. Many remarkable instances of success in making an imperfect river into a good navigable stream might be quoted both in Europe and North America, and which present instructive instances to the young engineer. The improvement of the river Liffey at Dublin, and the River Clyde in Scotland are goood examples. The improvement of that vast inland gulf, the Shannon, is now in the course of execution, after several years of most detailed and elaborate inquiries, estimates, surveys, and careful examination, the accounts of which may be studied with great advantage to both the experienced and young engineer. Upwards of half a million sterling is to be expended on this truly national undertaking. The learned professor then entered into a long account of the probable original ideas for the application of iron to roads, commencing with the wooden railways used in the collieries on the banks of the Tyne, near Newcastle, above 200 years ago, he then showed that the waste of timber led to the idea of covering wood with plates of iron, and ultimately to the present point of perfection—wrought iron rails—the introduction of which into general use does not extend further back than thirty years.

(To be continued.)

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Jan. 31.—P. HARDWICK, ESQ. in the Chair.

A paper by Mr. White was read on Fresco Painting, which will be found in another part of the Journal.

A paper "*On the Vaults of the Norwich Cloisters,*" by Prof. Willis, of Cambridge, (hon. member,) was read. The following is an abstract:—

The cloisters of Norwich Cathedral were begun in 1297, and not completed until 1430. Its four ambulatories represent four successive styles, the contrast in the details being rendered more conspicuous by the uniformity of the general design, which has been so much respected during the progress of the whole work, that even the isolated shafts, which form the proper mullions of the windows of the thirteenth century, have been continued throughout, contrary to the usual practice of the Middle Ages. The vaultings are similar in the general plan and dimensions on the four sides, but each is distinctly marked with the mode of treatment employed in the successive periods, and it is to the progressive variations in the form of the spandrils, exhibiting a gradual transition from a square section to a semicircular one, that the paper chiefly referred. In the oldest portion of the work, the eastern compartments, the horizontal section of the spandril, taken about half way between the plane of the impost and the crown of the arch, is perfectly square, and this form is more strongly developed—exaggerated, it may be said—by a slight setting back of the ribs between the cross springers and the diagonals, which gives greater prominence and and a more marked expression to the angle of the spandril. In the south walk, the next in chronological order, the intermediate ribs, instead of being set back, are brought slightly in advance of the other ribs. The effect of this arrangement is to give a polygonal character to the spandril, which is, in fact, still square in its general form. In the west walk, the polygonal character is fully developed, and the square abandoned, but the angles of the polygon are far from being equal. In the western walk, the latest portion of the work, four centred arches are introduced, and the curves of the haunches being all alike, and the middle section of the spandril circular, the polygon formed by the front edges of the ribs is equiangular, as in fan vaulting. These effects, continued the Professor, may be confirmed by the comparison of contemporary examples, but it rarely happens that they can be found in a series, and in a work of which the uniformity of design is for the most part preserved; so that changes of this kind are rather to be regarded in the light of embellishment, or as the modern improvements of the day added to the original design. Thus it is, that in this respect the cloister of Norwich is so valuable, by enabling us to discover many of those improvements which it is more difficult to pick out of examples complete in the character of their own age. The essay was accompanied by numerous sections, and a table laying down the exact curvature and arrangement of the vaults: all the curves are found, in conformity with all that has hitherto been observed on the vaultings of the Middle Ages, to be segments of circles, and not ellipses formed by projection, according to modern practice, which has, therefore, erred widely in the character of Gothic vaulting. This paper forms a sequel to that on the Vaulting of the Middle Ages in general, read by Prof. Willis, at the Institute, on the 5th of July, 1841. (See *Journal* for Aug. 1841.)

Feb. 14.—JOSEPH KAY, ESQ. V.P. in the Chair.

This evening was one of more than ordinary interest, in consequence of its having been announced that the long-desired wish of many members of both the Institute and the Architectural Society for the union of the two bodies would take place. There was a very full attendance, so much so that the room was crowded to inconvenience. The preliminary arrangements having been completed, 32 members and students of the Architectural Society were admitted, 11 as fellows, 8 as associates, and 13 as students of the Institute. The Architectural Society will, therefore, be extinct after a final *conversazione*, to be held at their rooms in Lincoln's Inn Fields, on the first instant. This union, we consider, will lead to very beneficial effects, and will give a firmer basis to the profession; so that we hope now that attention will be seriously turned towards remedying the evils respecting "Competition Designs," so long complained of.

ON FRESCO PAINTING.

A Paper read at the Royal Institute of British Architects, by E. T. PARRIS, ESQ., *on Monday*, 14*th Feb.*, 1842.

THE application of the higher branches of painting to architectural decoration, is a subject in which the members and gentlemen connected with this Institute have taken so much interest, that I need only refer you to the many valuable papers which have been read before these meetings on the art of polychromy, the works in the Vatican, and others relating to painting, all tending to prove that such embellishments are considered by the profession as essential to architecture.

The liberality of the council, by their invitations, show the earnest desire on their part to promote the permanent union of architecture, sculpture, and painting, and is, I am sure, fully appreciated by my brother artists, and every visitor present, as well as myself.

I have, therefore, endeavoured to collect together a few remarks founded on my own practice, in the hope they may assist in restoring that confidence so essential on both sides in carrying out great works.

It will be remembered that in 1821 a new ball and cross was placed on the summit of St. Paul's Cathedral; and as the interior was intended to be cleaned, the question was much agitated respecting the paintings in the dome, by Sir James Thornhill. It was stated publicly that the expense of raising a scaffolding would be so great that faint hopes were entertained of its being effected; I immediately turned my attention to the subject, and contrived an apparatus for the purpose of getting at the paintings. The model remained by me until 1829, when Mr. R. Cockerell, desirous of seeing the paintings cleaned and restored, submitted the model, in the most liberal manner, to the Dean and Chapter, introducing me at the same time as the inventor; the apparatus was considered adequate to the purpose, and my estimate for restoring the whole of the painting, gilding, &c. above the whispering gallery was £1000, and no charge for scaffolding! but this sum was too large, and the plaster has been dropping from the wall ever since—(it had then decayed above five feet all round the dome)—and I am certain that in a few years the whole of the brick work will be exposed. What could H. M. the King of Prussia think on entering our metropolitan cathedral? It may be readily imagined that the hope of employment on such a work, excited the liveliest enthusiasm, and I lost no opportunity of devoting every spare moment to experiments on stuccos and cements, as I fully expected on touching the plaster the greater portion would come down; my intention was, in that case, to propose the restoration and painting to be done in fresco, it having been originally painted in oil. Perhaps there are many gentlemen present who visited Rome from 1820 to 1825, and they will remember that Cornelius, Overbeck, Veith, &c., then were employed by Chev. Bartholdy to paint his villa in fresco. The attempt to revive this method of painting was considered an experiment, and the English patrons and artists looked on, talked about it, but did nothing; one gentleman, an architect and member of this Institute, in the most laudable manner tried to engraft it in this country, and had a large surface covered for that purpose in the Catholic Chapel in Moorfields.

The result of my experiments at that time, with much practice on large works since, together with the attention I have recently given to this subject, emboldens me thus to lay before you the following observations. I shall first endeavour to explain the different ways of using colours in painting, and offer my opinion as to the best appropriation of each to its particular purpose, and although fully aware that practical men, and experienced architects are acquainted with their qualities, yet there are many who, practising one mode of painting, are ignorant of all the others, particularly as applied to architectural decoration.

The covering large surfaces, and the representation of subjects and ornaments by colour, is performed in either what is called fresco, distemper, encaustic, or oil (with varnish or without) termed flatting.

Oil painting consists in using pigments mixed with oils, gums, or other vehicles, for the transparent colours, and with opaque bodies, such as white lead, and metallic oxides, for the lights; the extensive range or scale from light to dark, through all the varieties of colour, from the most delicate tint to the most juicy richness, gives it many advantages for general purposes, which no other mode possesses; the ease with which it is worked, the numerous re-touchings, toning, scumbling, glazing, &c., renders it a most fascinating medium to convey the ideas of the artist to the canvas, panel, or wall. Durability is another of its advantages; and it would appear to possess every requisite for embellishing the ladies' boudoir, the picture gallery, or public edifices of the greatest magnitude, or most severe character. But upon mature reflection it will be seen, notwithstanding the extensive powers of oil painting, that it is used to the best advantage when applied to certain sizes and positions, and when confined within panelling or framing, and so placed as to receive the light from a particular angle, as its glossy surface reflects all objects before it. The ceiling by Rubens at Whitehall will explain this, for since it was last cleaned, the canvass of the centre oval appears quilted, in consequence of the cord which suspend it rendering the surface uneven, and it can only be seen from a very few parts of the chapel without those shining little spots. The same cause operates upon oil painting, when applied to staircases, coves, and curved surfaces, and the staircase and saloon at the British Museum, the hall at Greenwich Hospital, and other places, are examples of its misapplication. It may be stated in answer to this, that there are many paintings on a large scale which do not shine; this must be allowed, but the cause is that they have, from age, &c., become mealy and dry in their shadows, losing all their transparency and richness, and in many cases the dark colours are covered with a grey cloud, and the usual cry is—How much they want varnish.

I am also aware of the various methods used to destroy the gloss of oil pictures when placed opposite to windows, as starch, rice, white of egg, and spirits, with several others; but in every case that I have seen and tried, the richness of the deep colours and shadows are reduced to the dullness of distemper; the excessive blackness in the staircase at the British Museum, &c., is occasioned by the boiled oil used in preparing the grounds to prevent damps from coming through; this never occurs in pictures painted with pure oils. Many attempts have also been made to unite the qualities of fresco, encaustic, and distemper with oil, by using one over the other.

Painting in distemper, or body colour, is so inferior to oil, that few artists in this country practise it for pictures, although much used in Italy. Yet it has some important qualities which fit it for purposes wherein oil would fail; it is a mixture of colours, with whiting and size, gum, white of egg, or other glutinous substances, it cannot be softened or blended without great difficulty, so that in most cases, where finish is required, the several tints are carried into each other by hatching with the point of a hair pencil, as in the Cartoons of Raffaelle at Hampton Court. Its extraordinary power of reflecting light equally, renders it best adapted for scenery and gay light decoration. Its chief characteristics are, that it represents air, distant landscape, architectural objects and sculpture, better than by any other means (when on a very large scale, and the spectator is kept at a distance), for on approaching it appears dry and unfinished. Its chief objection for architectural decoration is, that it suffers from damp, and is removeable with a sponge and water. Most colours can be used in distemper, even some that are useless in oil, as verditer and others; all the bright and rosy tints are seen to the best advantage when used in distemper.

Painting in turpentine, or as it is termed flatting or dead colour, is a modification of oil painting, no varnishes being used but turpentine alone (excepting the oil in which the colours have been ground). Its qualities are very similar to distemper, with the advantages that the colours may be blended and softened into each other; but dispatch and rapidity of execution is necessary, or the painting will shine in those parts where the brush has passed frequently over. It represents air and distant landscape equal to distemper, and may be carried to the extreme delicacy of finish; but on a very large scale, it loses its force in the shadows, reflects considerably less light, and appears weak in comparison with distemper, it is as durable as oil would be without varnish.

As to encaustic painting, I must confess my inability to explain its best qualities, or do it justice, the few experiments I have made and seen not being sufficient. Its general principles, however, consist in a mixture of gum mastic, wax, and gum arabic, boiled in water, and used with powder colours on dry plaster, canvass, or panel, after which a coat of melted wax is spread over the whole, and a hot iron applied to drive the wax into the painting, and to incorporate with the colours, by which they are rendered more transparent and bright. Another way is to prepare a ground of wax, paint upon it with distemper colours, and when dry apply hot irons, and it will be fixed.

In all my experiments, I never have been able to remove a cloudy appearance, or to drive in the wax equally, when on a surface of any size; but I believe the recent discoveries of the French artists have brought it to maturity. It was much tried a few years ago, and I have seen several pictures which were thought successful, but they never exceeded eighteen inches square, and had a semi-transparent appearance (from the wax) like marble; they must be very permanent, and resist the damps of a moist climate. Durability without gloss is its chief advantage, it can be retouched and painted upon at any time, so that careful cartoons, and a thorough knowledge of drawing are not so essential as in fresco.

Fresco, a term not generally understood, was greatly talked about 20 years ago, and at last has become a question of national importance. It was supposed a secret and mysterious operation, whereas of all other modes of painting it is the most simple; I am therefore astonished that many writers upon it, and some of them artists, should bring forward such opposite opinions, when a single experiment would prove the permanency of the colours, and explain the whole affair.

From numerous experiments I have made, I believe that all our usual mortars will answer equally well, as far as the operation of applying the colours. The durability of the stucco is another consideration; the practical plasterer will know what mixtures work the best, and the experienced architect can inform us of the materials to endure the tests of time and climate.

I think it not likely the Greek artists used exactly the same composition for their stuccos in their own country, as they did at Pompeii and Herculaneum, or that Masaccio, Michael Angelo, or the Sicilian artists, painted on a preparation, precisely the same as those now practising at Munich, and I am convinced that the painter will find walls, and stuccos, ready prepared to his hands for fresco, as good as he can desire, either in England, Russia, India, or America.

The process consists in laying and spreading very even, a mortar composed of lime mixed with either sand, pulverized flint, bricks, or glass, and while it is fresh and moist, to apply colours prepared from earths and minerals, mixing them with water, the whole will become chemically incorporated and fixed when the stucco is dry, and will become so hard by time as to bear rubbing with a wet sponge or cloth. It must be remembered that vegetable colours will not stand. Those to be used in fresco painting are few, of a deep sober tone, of great intensity, and are very brilliant when judiciously contrasted. In this the knowledge of the artist is called forth, as in every other method of painting, and a very little practice will teach him the few changes which take place in the drying of his tints. Although small works of the greatest excellence have been executed, and by the first masters, yet the proper field for fresco is in figure subjects on extended surfaces, and it is most effective when in conjunction with sculpture and architecture.

As a decoration, it surpasses every other mode of painting; its grand and impressive tone of colour, with a boldness and decision of outline rejecting all meretricious ornament, and its combining with large masses of architecture, give a dignity and majesty commanding silence and admiration.

I must observe that much of the richness and brilliancy of fresco, depends on the stucco ground reflecting light through the colours, and Indian red, when applied on a large surface, appears as beautiful as the richest lake in oil. The colours never grow darker, nor do they suffer from absence of light. Their durability is beyond a doubt.

A very general impression exists, that any painting done on a wall is fresco. This is a mistake, as none of the works by Thornhill, Verrio, and others, are in fresco but in oil; also that the scenery at the theatres is fresco; they are not so, but in distemper. In fact nothing can properly be called fresco that is touched after the fresh mortar is dry and it is moreover supposed that the English artists are entirely ignorant of this mode of painting. This again is not true; many have tried and succeeded; and there is an interesting account in the "Art Union," of last year, describing a work by Thomas Barker of Bath, thirty feet long, and twelve high, full of figures the size of nature, painted in 1822, about the time that the German artists, commenced fresco painting.

Fresco painting, ancient stained glass, objects in terra cotta, bronzes, tessallated pavements, with painted and gilt monumental effigies, armour, and old tapestries, seem to partake of the same qualities, that of a sober, powerful, rich, and if I may so use the expression, a ponderous character, which accords not only with each of these, but with every style of architecture.

In opposition to this painting in distemper, turpentine and oil require to be modified or humoured to suit the exact tone of the apartment; the Venetian artists well knew this, and their oil pictures were frequently painted very rich and dark, to harmonize with coloured marbles, velvets, brocades, embroidery, and carved ebony, with which they were surrounded, but as form and outline were absorbed in those powerful effects the higher style of art became disregarded.

Enough was done by Rubens to show the value of painting as an architectural decoration; and although the possession of the cartoons produced no commissions for our native artists, yet the nobles engaged Verrio, Rizzi, Pelegrini, Rousseau, Delafosse, and others, to cover the walls and ceilings with their preposterous deities in silks and satins, powder and perriwigs.

Thornhill, an Englishman, endeavoured single handed to form a school for his country, which was encouraged while he lived. It is however stated by his son-in-law Hogarth, "that the upper end of the hall at Greenwich, where the royal family is painted, was left chiefly to the pencil of M. Andrea, a foreigner, after the payment originally agreed upon for the work was so much reduced as made it not worth Sir James' while to finish the whole with his masterly hand."

It is curious to note the scale of charges for architectural decoration for the last 200 years. That is from the arrival of Rubens in 1630 to 1730, when Thornhill was in his zenith; and from 1730 to its almost total extinction in 1842.

1630	Rubens, for Whitehall ceiling	£7	10	per yard
1670	De la Fosse, British Museum	7	0	„
1690	Verrio, exclusive of gilding (with 200*l.* per annum when blind)	3	12	„
1725	Thornhill for Greenwich	3	0	„
1730	Do. pilasters	1	0	„
1775	Cipriani for cleaning the Rubens ceiling, £2000.			
1777	Barry for the paintings in the rooms of the Society of arts, after being furnished with colours received by the exhibition, £503. 2*s*.			

The practice of fresco painting will be found to produce strong sensations both in the artist and the public, and they will discover hidden beauties at present scarcely known to exist; it will draw the attention of the painter to works of art hitherto glanced at as being out of his style—the Elgin marbles will become properly appreciated, he will disseminate the admiration to his pupils, and through them the public will have their eyes opened to the riches they possess in those inestimable treasures of art.

It is objected that fresco painting cannot be removed like oil. I beg to refer to those painted by Paul Veronese, and brought to this country a few years since. It may be done on slate. I do not insist that fresco is either better than oil or encaustic, or that it is more effective, except for particular purposes, but it has advantages over every other style; it can be done in less time for less cost, and produce a larger income to the artist; is certain of raising the arts as well as the taste of the manufactures, consequently must increase the revenue of the country.

In fresco painting, the artist requires numerous assistants, and some of his own creating; they must be his pupils, with them he receives premiums for instruction; he has also the benefit of their aid, and is therefore not obliged to devote so much of his own manual labour to express his thoughts; and when he commences his work upon the wall it is soon dispatched, while the scaffold is up and the wall damp, without waiting for its drying, and then four coats of oil, and a flat before he begins.

The ability of our artists in drawing is part of the great question; it will be seen and more fairly decided when the sketches of foreign artists are placed beside them, if they will come forward by the general invitation to artists of every nation; if they do not, they are not entitled to be employed. Models for sculpture should be limited in size, and decided upon after three months public exhibition.

After the first selection is made, the artist and architect would be "working in conjunction and in aid of each other," as desired by the select committee; each would appreciate the talents of the other as they became developed, and the architect would be saved the mortification of having his edifice encumbered by a mixture of German saints, Greek and Roman heroes, and paintings of Turkish battles, all perhaps good in themselves, but destructive to his design from their wrong application.

It would be necessary for the architect to have proper scaffolding, and other conveniences as the decorations would then really form part of his undertakings and estimate.

I must now leave this and all other remarks to your consideration, and sincerely trust that what I have stated will be understood as not intended to draw forth opinions, but experiments. I have endeavoured to explain the results of mine, and if I have made erroneous conclusions, I am sure that no one will more gladly be undeceived when proofs are given to the contrary, and I trust we shall be able of ourselves, not only to embellish the Houses of Parliament, but all other public edifices, without foreign aid, both in oil, encaustic, and fresco.

REVIEWS.

Papers on subjects connected with the Duties of the Corps of Royal Engineers. London; John Weale, 1842.

We have before us the fifth volume of papers by the Royal Engineers, one of increased size; and we have not yet seen the third volume of the Transactions of the Institution of Civil Engineers, although upwards of two years have expired since the second volume appeared. It was, in fact, in Nov. 1838, when that volume was produced; and as the first volume of papers by each body was commenced at the same time, there must, in our opinion, have been great remissness on the part of the Institution, in allowing their military brethren to get so much ahead. Want of papers can be no plea in excuse for this delay, for there are plenty of them read at the meetings, many of which, well worthy of publication, are doomed to seclusion in the portfolios of the society. We shall not, therefore, witness the continuance of this state of affairs, without feeling it our duty to comment upon it more strongly.

When it is considered that the interest of the papers is enhanced by their speedy publication, we cannot but regard this delay as most injurious both to the progress of science and the interests of the profession. The civil engineer and the royal engineer will both be judged by their deeds; and if the latter succeed in bringing forth three volumes to one, they will naturally become more familiar to the public, and in the end perhaps supplant the civil engineers in all government works, an enterprise which will but too well meet the encouragement of the ruling powers. When it is further considered that the royal engineers are united on this occasion merely by a private compact, and that the civil engineers form an incorporated body, we think it becomes the bounden duty of the Institution to be more zealous in their exertions, and more liberal in their measures. It is their duty to promote science, and to diffuse information; for the more the public becomes enlightened as to the powers of the engineers, the more will they be disposed to encourage public works.

Having said thus much, we shall proceed to examine the contents of the volume before us, of which the first two papers are purely military. The third paper is on the removal of a wreck; and the next paper on the Madras Lighthouse, and the mode of its illumination. The fifth paper, by Lieut. Nelson, R.E., treats of the varieties of timber, and has tables of their degrees of strength. Many of the specimens are of woods upon which hitherto no report has been made. We regret to observe, as we have on previous occasions of this kind, that the experiments were not made on larger scantlings; nevertheless the paper appears to be got up with care, and to be more copious than any we have yet seen. The next paper is on the canal navigation of the Canadas, by Lt. Col. Philpotts, illustrated with maps and a plan, sections, and details of one of the locks. The seventh is a description of a traversing crane of considerable strength, used by the Butterley company, well adapted for raising great weights, communicated by Mr. Joseph Glynn. The eighth is an interesting paper by Major Jones, R.E., on the method of building in Malta. The next paper, on drawbridges, is a valuable communication from Lieut. Douglas Gatton, R.E., chiefly derived from the French of M. Poncelet. It isillustrated with three plates, containing several varieties of this kind of bridge. The tenth paper illustrates, in much detail, Mr. Napier's machinery for the manufacture of leaden bullets by compression, by which 25,000 bullets can be produced in a day. In the next paper the editor describes the new dock constructed at Woolwich under his superintendence, in conjunction with Mr. James Walker. Mr. Miles, in the twelfth paper, gives an elaborate account of Huddart's rope machinery used in Deptford dock-yard, whose patent has now expired. It is accompanied with seventeen beautiful engravings by Le Keux, drawn with great accuracy, and exhibiting all the details. To persons who feel an interest in this subject, we recommend this article for perusal. The next paper is on the theory and practice of sinking Artesian wells, including one at the model prison, Caledonian Road, Islington, which is the deepest yet sunk in the chalk of the London basin and shows the abundance of water to be obtained from that stratum.

It will be seen, from the list of papers which we have given, and from the extent of illustration, how much the editor has exerted himself for the improvement of his work. We hope hereafter to make some extracts from this work, to which we have not now space to do justice.

Remarks on English Churches, on the expediency of rendering Sepulchral Memorials subservient to pious and Christian uses. By J. H. MARKLAND, F.R.S. & S.A. Oxford: Parker, 1842.

MR. MARKLAND'S book is rather addressed to the public than to architects; but it will render essential service, by directing men's views to the many considerations connected with ecclesiastical architecture. To preserve the works of our ancestors from decay, and to protect them from the injuries inflicted by barbarism—to add our share to the accumulated architectural wealth of ages—are obligations which cannot be too generally enforced, and which are well urged by our author. His work is one of a numerous class which we see issuing from the Oxford press, betokening the increased interest of the clergy in ecclesiastical architecture, a feature which we are glad to recognize, as the clergy have mainly assisted in the decline of that art, and are the parties who can most efficaciously co-operate in its restoration.

The Year Book of Facts in Science and Art. By the Editor of "*The Arcana of Science.*" London: Tilt and Bogue, 1842.

THE numerous facts contained in this yearly volume afford a complete index to what has been done during the past year in the arts and sciences; it is a book full of useful information collected from several periodicals, and shows the industry of the editor in stringing together so much valuable matter.

Telegraphic Railways, or the Single Way recommended by Safety and Economy. By WILLIAM FOTHERGILL COOKE, ESQ. London: Simpkin Marshall, and Co., 1842.

MR. COOKE, the co-patentee of Professor Wheatstone in the electric telegraph, has written this small volume to illustrate its working, and to show the economical advantage which may be derived from its employment. The author shows clearly that in the majority of cases, the application of this apparatus will enable companies to work a single line with safety, and so to avoid the great and heavy expense of double ways, so unsuitable for a restricted traffic. This is done with impartiality, although an inventor is speaking of his darling project. Mr. Cooke has made out a very strong case, which we think highly calls for the enquiry of the railway proprietor and engineer.

Illustrations of the Architecture of Nicholas Goldman. By H. AUSTEN, Architect, Liverpool. London: Green, 1841.

MR. AUSTEN'S re-publication of Goldman's work is too expensive for students, and the illustrations badly executed; nor is the small quantity of letter-press carefully edited.

ON INCREASING THE EVAPORATIVE POWER OF BOILERS.

SIR—Perceiving in your last Journal a review of my suggestions for increasing the evaporative power of boilers, and also for preventing the nuisance from smoke, in which the writer has indulged more in wit than argument, I beg, while passing over the former, to reply to that portion of his review which bears on the above important subject, and, at the same time, is more in harmony with the scientific nature of your useful work. The reviewer has indulged in much personal matter, and even personal abuse; but as I have not leisure to comment on such, and am persuaded you would object to have your valuable columns so occupied, I will confine myself to the scientific and practical, leaving the figurative and redundant matter to the neglect which is perhaps its best reward.

After a long quotation from the Mechanic's Magazine, (No. 950,) giving the substance of a communication made by me to a highly intellectual and practical auditory at the Polytechnic Society of this town, in which I explained a mode of increasing the evaporative power of boilers, by the transmission of heat, *longitudinally*, through metallic bodies, (and the whole of which quotation I assert to be substantially correct,) the reviewer observes, "Well: if this be not carrying absurdity to an imperial pitch, we do not know what is." Now Sir, I can only say that this "imperial absurdity" has yet to be pointed out; for assuredly none of my auditory were able to detect it, during their examination of the experimental boilers then in action before them, and after an interesting discussion to which it led. I may also observe, that after I had concluded, Mr. Dewrance, the engineer of the Manchester and Liverpool Railway, stated to the meeting that he had inserted 105 such conductor pins into one of the company's stationary engine boilers, and that it was attended with so decided an effect, that the boiler now produced an abundance of steam, although previously its supply was very deficient.

Yet what is this "absurdity," of which the reviewer speaks? Neither more nor less than the practical application of the well-known theory of "conduction," which may be found in every work of authority, treating on heat, and its transmission through metals. The application of this heat-conducting power of metals, of which I avail myself, is by introducing metallic pins projecting a given length into the flues of boilers, and by which a greater quantity of heat will be conducted to the water than would be due to the area which the pins displaced. On this head, the reviewer quotes the words I used, viz. "The half-inch circular portion of the flue-plate which such pin has displaced, is thus made to possess the faculty of transmitting as much heat *as is received and absorbed* by nine half inches superficial" (the pin being half an inch in diameter and three inches long). Now this statement, I repeat, is strictly true, in defiance of the reviewer's charge of "absurdity." The reviewer, however, putting his own erroneous interpretation on these words, raises an imaginary superstructure, which he attacks with genuine Quixotic ardor, and equally Quixotic effect, for he adds, "by which we understand that the pin has the effect of transmitting to the water nine times as much heat as the half-inch disc it displaces." Now this is a mere gratuitous misunderstanding of a very plain position. I did not give any *measure* or *quantity* of heat, so transmitted; I merely said, "as much heat *as is received and absorbed*;" for on this very distinction depends the whole question, inasmuch as it is an ever-varying quantity, and influenced by numerous physical and accidental circumstances, such as, the length and thickness of the pin—the nature of the recipient—the part of the plate in which it is inserted—the quantity of soot or other non-conducting matter with which the flue may be lined—the strength of the draught or current through the flues—and the temperature of such current.

Nowhere, however, will he find me committing the practical error, which he puts into my mouth, of measuring the quantity of heat transferred, by reference to the mere surface area of the pin, spike, bar, or plate. Indeed, had the reviewer examined impartially and quoted fairly, he would have found in the very report from which he quotes, (see Mechanic's Mag., No. 951,) that such is the reverse of what I inferred; for I there stated that three-inch pins were practically the best, repudiating the idea of increase of surface being commensurate with increase of heat.

Whether the area of the disc of the plate displaced will transmit heat in proportion to the surface of the conductor pin, will depend much on its length and other circumstances. I am prepared, however, to prove that a pin half an inch in diameter and three inches long, inserted into the side of a flue plate, will absolutely convey more heat than nine half inches of the plate surface, although I do not assert the same thing of other lengths. Besides, there is another consideration which requires attention, namely, the distance of these pins from each other; since, were they too close, they would counteract the object intended, and prevent access of the mass of moving heating gases to their sides or surfaces. Indeed, in certain parts of the flues, particularly of marine boilers, I believe the heat transmitted will considerably exceed the above proportion of nine to one, a point which hereafter will be practically illustrated.

Of the transmitting power of a metallic conductor, if the reviewer will consult "Brande's Manual of Chemistry," (2nd ed. p. 155,) he will there find the doctrine explained, and a diagram, representing the very experiment, as I saw it illustrated by Professor Brande himself, in his Lectures at the Royal Institution, and which first suggested to me the idea that longitudinal conduction by metallic pins was available for increasing the effective heating surfaces of boilers; and on this ground, that the receiving or heat-absorbing surfaces were large, and the discharging or conveying areas were small—a circumstance which so admirably fell in with the restricted conditions of marine boilers. To this also, I soon found that in practice the system of *longitudinal* conduction had another important feature, namely, that it extended or projected the receiving surfaces, beyond the mere surface of the plate through which the pin passed, and which too often was covered by a coat of non-conducting soot; and further, that the pins presented themselves to the direct action of the current of heated gases, whereas the plates themselves lay in the same direction and plane of the current, and therefore receive but indirectly, and in a less degree, the heat of such current.

Practice has since fully established the correctness of Mr. Brande's illustrations, and the inferences which I drew therefrom; and I can assure the reviewer, that although there were above 1000 persons present, none ventured to call the theory an "absurdity," or imagine that he meant to say that the heat transmitted was in the ratio of the surface and sectional area of the bar he employed.

The mistake, however, into which the reviewer has fallen, and in the enjoyment of which he revels, has arisen from his overlooking the fact, that this conducting power of a given length of bar, though true to a certain extent, is nevertheless not infinite; and that the mere amount of surface is not to be taken as the measure of the heat transferred. This I have sufficiently explained; the reviewer, however, led away, no doubt, by the heat of his own imagination, has taken the length of the bar and the stretch of his own fancy as equal measures of inferential absurdity.

The reviewer observes, "These spikes will, of course, speedily attain the temperature of those particular parts of the flue where they are inserted." This, I take leave to say, is another of the practical errors into which his fancy (or, perhaps, a foregone conclusion that Mr. Williams must be proved to be wrong,) has led him. If this doctrine were true, then we should find the plates also of a boiler attaining the temperature of the flues adjoining, which would at once negative any conducting power. So far, however, from these spikes attaining such high temperature, practice proves, that so long as water is the recipient of the heat they convey, the temperature is, in fact, so low as to be touched without inconvenience, the heat passing through them as fast as it is received, thus preventing such an accumulation of heat as would injure or effect their structure; such, indeed, is the well-known cause of the material of all boilers remaining uninjured, although exposed to very intense heats. I here beg to refer to a paper and diagram in the Mechanic's Magazine, No. 967, in which I have gone more at large into this important subject.

I here pass over the strange train of reasoning which the reviewer indulges in, and the equally strange hypothesis he broaches, manifestly from the mistake above noticed; namely, that "a single spike will be as efficacious as any given number of spikes, provided it have a commensurate surface," and the ingenious corollary which follows, that "since a given quantity of spike surface is, by hypothesis, of equal efficiency to the same quantity of ordinary flue surface, an excellent boiler may be constructed *without any flue surface at all!*" How any one could deduce such extravagancies from the well-known theory of conduction, is not for me to say. Doubtless under the influence of his imaginative powers, the reviewer had forgotten this theory; for, as Pope observes,

> "Where beams of warm imagination play,
> The memory's soft image melts away."

As a plain, matter-of-fact man, however, I beg to refer the reviewer to a diagram (see Mechanic's Magazine, No. 951, containing the very report from which he has so largely quoted,) describing an experiment which he may at any time make. He will there see two boilers described, having the same extent of flue surface, and in every respect alike, with this exception, that one was furnished with conductor pins, while the surface of the other was plain. Yet, with the same measure of heat, (from thirty cubic feet of gas,) passing through the flue, the former evaporated 8 lb. 5 oz. of water, and the latter but 4 lb. 14 oz. Such experiments, which convince ordinary men, however, appear to have no effect upon this imaginative genius and hypothesis-monger, for he observes, of the value of practical experiments, that "though we cannot fail to be convinced by such an argument, we unhappily are not converted." "Unhappily!" I repeat. But we have good authority for saying,

> "A man convinced against his will,
> Is of the same opinion still."

On the second part of the reviewer's labours—respecting the "smoke-preventive plan," fearing to occupy too much of your valuable space, I will defer its consideration to my next communication.

I am, Sir,
Yours, &c.
Liverpool, Feb. 16. C. WILLIAMS.

[We very much regret that Mr. Williams has not favored us with the remainder of his comments, as it is our particular desire that all controversial articles should be brought to a close as soon as possible, and not be allowed to take a range over the Journal for several months, we must therefore request that Mr. W. will conclude his communication in the ensuing Journal. We have received two or three other communications on the same subject, which for want of room we are obliged to postpone until next month, when we shall offer some remarks on their contents, as well as on Mr. Williams's communications.—ED.]

SANDSTONE.

SIR—Will you allow me space in your valuable journal, to ask for information concerning sandstone as a *building material?*

I live in a neighbourhood which abounds in red and white sandstone, both of which are frequently used for building; but I have heard many complaints uttered against its use, on account of its great absorption of water, while others affirm that it is equally dry with brick work, provided it be used in the form of rubble work, and well flushed with mortar. It is important, in many places where sandstone abounds, to ascertain its nature with relation to its absorption, because its cheapness renders it very often desirable to use it. Some persons also have great objection to brick buildings, preferring the appearance of the sandstones from the neighbouring quarries, which often present in rubble work a very pleasing and picturesque appearance of warm tints of a variety of hues.

I am just about to build a house for myself, and should feel greatly obliged by any one favouring me with any facts connected with this subject, particularly as they are of general importance.

I am, Sir,
Your most obedient servant,
SANDSTONE.

[If our correspondents will refer to the second volume of the Journal, he will find some valuable information on all kinds of stone.—ED.]

EVAPORATION OF WATER IN MARINE BOILERS.

SIR—Can any of your readers state the results of experiments made under their own observation on evaporation of water in boilers for land or marine engines of the usual construction; the results to be given in the following form:—Dimensions of boiler—Water evaporated in lbs.—Coals consumed in lbs.—Description of coals used—Time occupied in the experiment.

I think such information may be applied to some advantage.

Your obedient servant,
N. H. A.

[We refer our correspondent to Mr. Wicksteed's very elaborate experiments detailed in a work lately published, and which was noticed in the Journal of last year.—ED.]

ON THE ORIGIN AND HISTORY OF THE OBLIQUE ARCH.

SIR—Your correspondent Oliver Twist, after describing the Loughborough and Stamford Road Bridge, on the Midland Counties Railway, makes the following assertions:—" The above is a unique specimen, being the only one ever erected, and is the bold invention of Mr. Woodhouse, and was erected in 1839—40." As the preceding is an incorrect statement, I beg you will insert in your next number this refutation, in order that, to use your correspondent's own words, " the real inventor may have his due meed of praise."

An oblique bridge of a precisely similar design was erected by Mr. Gibbs, the engineer, over the Croydon Railway, near the Jolly Sailor station in 1838, and I am informed that the peculiarities of the design were pointed out by that gentleman to Mr. Woodhouse during an examination of the system of longitudinal bearings adopted on the Croydon Railway.

Mr. Woodhouse would doubtless verify this statement, as I am convinced he would be unwilling to profit by your correspondent's inadvertency.

Feb. 23, 1842. ALETHES.

BLECHINGLY TUNNEL.

This work, which is upon the line of the South Eastern and Dover Railway, is now completed: it is nearly three quarters of a mile in length, and is constructed through a hill forming part of the Wealden formation of geologists, consisting of a blue clay marl, most remarkably distorted by an upheaving force at some remote period, which has caused the hill to be full of faults, and occasioned considerable difficulty in the mining operations. In the course of the work the fossil remains of the Iquanodon and other reptiles have been found. The width of the tunnel in the clear is 24 feet, its height 21 feet above the level of the rails, with an invert having a versed line of three feet; its figure is elliptical. The work was carried on by means of twelve working shafts of nine feet diameter, and progressed with extraordinary if not unexampled rapidity, no less than 264 yards having been began and completed in one month. The bricks were all made on the spot, and upwards of thirteen millions were made in the course of last summer, a considerable quantity having been previously made and dried in flues during the preceding winter.

The greatest number of men employed at one time was about 1,000, and only two men lost their lives in the course of the work, which casualties arose from their own imprudence when using gunpowder.

LIGHTNING CONDUCTORS.

Sir—I am about to put up an iron rod to a church tower as a lightning conductor, and you would oblige me very much by informing me in your next *C. E. & A. Journal*, whether the holdfasts may be iron also, or whether they *must necessarily* be of any other metal. I am not sure that if made of iron they would not conduct the lightning to the masonry.

Birmingham, Feb. 24, 1842. AN OLD SUBSCRIBER.

[We are averse to the use of iron for hold fasts, although they are generally used for the purpose, if iron be used, we should recommend them to be of *cast* iron, as being more durable than wrought iron; but we advise that a supporter or holdfast be made either of glass, which can be cast very thick for the purpose, or of slate slab, both non-conductors of electricity, and not so liable to expand, or to be operated upon by the changes of the weather as metal—they can be let into the stone-work, and pinned in with cement. It is very advisable to see that the end of the conducting rod is let into the earth four or five feet.—ED.]

STEAM NAVIGATION.

THE STEAM SHIP "LITTLE WESTERN."

We have taken an opportunity of visiting this vessel, in order that we might gratify our readers with a description of her machinery, which, on account of the peculiarity of its construction, and the reputed speed of the vessel, has become an object of considerable interest. The form of the vessel resembles that of the fastest Gravesend steamers, but sharper at both ends; the paddle wheels are of Morgan's construction. The ribs of the vessel are of T iron; the exterior or shell is composed of plank about 4 inches thick. The boilers are of that description known as Spillers. Each boiler consists of a large internal chamber, in which the fire is situated, and above the fire several rows of brass tubes of about 2 inches in diameter are arranged in a direction differing by a few degrees from the horizontal line. The water is contained within these tubes which communicate with a water space at each end: the flame and hot air circulate *outside* of the tubes, and the deflection of their direction from the horizontal line has the effect of maintaining a constant current through each tube, thereby obviating the difficulty which has been found to attach to other tubular boilers, in which a pipe, if heated in the middle, has been found to generate steam which expelled the water out of each end, the elasticity of the steam preventing the water from again entering.

The engines are by Messrs. Acraman & Co., of Bristol, of 80 horse power each, and the nature of their general arrangement may perhaps be more clearly imagined by supposing a pair of common land engines to be turned upon their ends, that is, placed with the cylinder in a horizontal position, the cylinder being beneath and the connecting rods above. Upon the keelsons of the ship the two cylinders are laid horizontally with the usual space between them, and from each side of each cylinder a column arises to support the paddle shaft. The piston rod is attached by straps to a beam supported with columns in a vertical position, and from the upper extremity of the beam the connecting rod extends to the crank. The column which supports the one end of the beam centre is connected with the column which supports the one end of the paddle or intermediate shaft with three strong turned malleable iron stays, by the means of which the requisite stability is obtained. The inner end of each beam centre is prolonged sufficiently to support a short lever, and each of these two levers works an air pump. The two air pumps therefore stand between the engines, at a distance from the line of the beam centres equal to the length of the levers.

The piston rod works through both ends of the cylinder; it is somewhat larger than piston rods for the same power usually are, is formed of brass, and is cast hollow. The steam and eduction valves are common double-beat valves of the same description as the expansion valves in common use. There are two steam and two eduction valves, as is the usual practice when spindle valves are employed. These valves are wrought by an eccentric upon the intermediate shaft. The spindle of one valve does not pass through the spindle of the other, but the whole four valves are arranged in a suitable chest above the cylinder. The operation of reversing is accomplished not by a loose eccentric, but by a double ended lever. The end of the eccentric rod, therefore, is made with two notches, and is maintained in the upper notch when desired, by means of a little sliding guard or shield.

The air pumps are of brass, and there is a marked peculiarity in their construction. The air pump pistons, instead of being provided with valves through which the water and air ascend preparatory to their being expelled during the *ascending* stroke, are made without valves, by which means the air and water are to be expelled by the *descending* stroke. In ordinary air pumps the piston is a *bucket*, in the air pumps of these engines the piston is a plunger. This species of arrangement has been previously tried, though with imperfect success. The air has been found to accumulate under the plunger, so that when the plunger was drawn up, the air, by expanding, filled the intended vacuous space, thereby preventing an adequate quantity of water from entering the pump chamber from the condenser. The consequence of this defective action was an imperfect vacuum in the condenser, and consequently an inadequate performance of the engine.

The evil of the accumulation of air beneath the plunger, might probably be corrected by causing the plunger to travel past the port, the lower side of the plunger being also made to slope downwards from the port. We are informed that in the *Little Western* there is no provision of this description, or of any other for correcting this evil, and we have further been informed that without any such corrective appliance, the evil is found to be inoperative or inexistent. We confess we are unable to resolve this apparent inconsistency.

The advantages of the mode of construction of the air-pump pistons which Messrs. Acraman have adopted are eminent and manifold, and that any accumulation of air beneath the piston may be prevented by a proper arrangement we are thoroughly convinced. The greater part of the noise the working of an engine occasions, arises from the action of the valves in connection with the air pump, and there is much leakage often through them, and much wear and tear. Messrs. Acraman's arrangement will go far to prevent this, and the benefits of the system would be materially enhanced, if the action proper to the foot and delivery valves were accomplished by the agency of a simple form of slide valve. There would then be no noise at all, and the vacuum in the condenser would probably be something better than in ordinary engines; for in ordinary engines there must always be a difference of pressure between the air pump and condenser sufficient, with the difference of the level of the water to open the foot valve. The best engineers, by placing their foot valves nearly perpendicular, render the difference of pressure between the vapour in the condenser and that in the air-pump barrel, very inconsiderable, yet there is a difference in all ordinary engines, and this difference would be extinguished by discarding the foot and delivery valves in favour of a slide valve, which would accomplish the work of both.

The workmanship of the engines is very superior. There are no rust joints, but all the surfaces intended to be fitted are planed and made tight by a little red lead; there is no gasket joint between the cylinder and cylinder cover, but both surfaces are made quite true, and then a little red lead renders them perfectly tight. There are many advantages in this mode of fitting which we are happy to find is now adopted by the most eminent of our engineers. The pressure of steam in the boiler is 6½ lbs. The speed of the vessel is about the same as that of the Eclipse, Railway, and Blackwall.

The *Little Western* is certainly a favourable example of the skill of Bristol mechanicians, but that there is anything either in the structure of the hull or machinery pre-eminently excellent, we utterly deny. In the production of the vessel there appears to have been too great a straining after novelty and there are evidences of a disposition to select arrangements, not so much by the consideration of what is excellent as of what is unusual.

The following are some of the proportions of the vessel and engines; she is 721 tons, measures between perpendiculars 200 ft., over all 216 ft., keel 195 ft., breadth of beam 27 ft.. and including paddle boxes 47 feet, length of saloon 44 ft. by 24 ft. wide, ladies' cabin 20 ft. long.

The East India Company's Steam-frigate Memnon.—On Tuesday, 22nd ult., this splendid vessel, of 1,100 tons burden, mounting two 64-pounders, and four 32-pounder guns, and having them and all her shot on board, with about 300 tons of coals, and a heavy cargo sufficient to test her capabilities for a long voyage, left her moorings at Blackwall, and proceeded down the river in excellent style, for the purpose of ascertaining the efficiency of her engines and sailing qualities. The Memnon was built by Mr. Fletcher, and the engines, of 400-horse power, were constructed by Messrs. Maudslay, Sons, and Field, with copper boilers. The cylinders are double, the steam can be used expansively, and the consumption of fuel regulated to suit any circumstance of slow or quick sailing; she has also disconnecting gear to work one wheel without the other, if found necessary. On arriving at Longreach the full power of the steam was applied, and the engines worked beautifully, the vibration being scarcely perceptible; the large wheels, 26 feet in diameter, entered the water with such effect as to propel the vessel, with her heavy cargo, at the rate of 11¼ miles per hour, affording the greatest satisfaction to her commander, Captain Powell, and all the gentlemen present. She proceeded as far as Sheerness before returning; the manner and simplicity with which the disconnecting gear (Mr. Field's patent) removed the stupendous paddle-wheel and again attached it in an incredible short space was exhibited, it surprised the naval officers, who had never witnessed any thing of the kind before.

Royal Mail Steam Packet Company.—The *Medway*, another of this company's vessels, built by Mr. Pitcher, with engines of 400 horse-power, by Messrs. Maudslay, Sons, and Field, made an experimental trip down the Thames at the beginning of last month. She performed the trip to the admiration of all on board. The interior fittings combine both taste and convenience, and are in perfect accordance with the magnificence of the ship and engines. Another vessel, the *Trent*, with engines by Messrs. Miller and Ravenhill, was to leave the Thames for Southampton on the 27th ult.; we shall notice this vessel next month.

Plymouth, Feb. 14.—The sides of steam vessels on which coal boxes are fitted are ordered to be lined with sheet copper. This is in some measure to prevent the ship from taking fire, should (as on board the *Avon*) spontaneous ignition of the coals occur. Means for better insuring the safety of the crew and passengers, in the event of fire obliging them suddenly to abandon the vessel, are also now provided by the Board of Admiralty, at the recommendation of the committee of master shipwrights, ordering boats of two thicknesses of plank, lined between with felt, to be fitted to the paddle boxes of steam vessels.

Steam Navy.—It is in contemplation to increase the power of most of the steam frigates now in the service, the whole of which, with but one exception, are considered not to have sufficiently powerful engines for all the purposes for which a steamer may be required; that although their present power may answer very well in fair weather and smooth water, yet at the time, their services are most required, in a squall on a lee shore, it will scarcely enable them to hold their own, much less to assist other ships. The *Devastation*, *Vixen*. *Geyser*, *Driver*, and *Styx*, are steam frigates of about 1,100 tons each. The *Devastation* is the only one of them that has sufficient power—her engines being 400 horse power; the engines of the others being only 285 horse power.

MISCELLANEA.

Railways Report.—The Officers of the Railway Department have presented a Report to the Earl of Ripon. President of the Board of Trade. This report, which is presented to Parliament by command of Her Majesty, is dated the 5th of February, 1842, and contains a voluminous mass of interesting information relative to railways. From the returns of accidents it appears amongst other things, that during the year 1841 the number of accidents on various railways, which arose from causes beyond the control of passengers, or, in other words, from carelessness, and want of proper precautions on the part of the railway companies or their servants, amounted to 29. By these accidents 24 persons were killed, and 72 injured. During the same year there were 36 accidents attended with personal injury to individuals, owing to their own negligence or misconduct, by which 17 persons were killed, and 20 injured; 60 accidents occurred which were attended with personal injury to servants of the company. under circumstances not involving danger to the public; by these accidents 28 individuals were killed, and 36 injured. Thus there were altogether 62 human beings whose lives were sacrificed by accidents on railways during the year 1841.

River Bourn, or Intermitting Springs of the North Downs,—In the Journal for March 1840, vol. iii., page 103, we gave some particulars of the outburst of this remarkable spring in the valley near the Half Moon Inn at Catterham Bottom, on the turnpike road from London to Lewis. We therein stated that the outburst at that time was remarkable for its having taken place at a much shorter interval of four years; however, in November last, being an interval of not quite two years, the spring burst again, and has continued flowing, without intermission, to the present time, and has given forth a much larger volume of water. We refer our readers to our former article for the particulars of this interesting phenomenon, and invite the attention of the scientific and the engineer to the subjects. To the latter it is important, as the occurrence of these springs are not unusual in the chalk formation, and at the last outbreak of the one in question, the engineers then constructing the works of the Brighton Railway suffered a serious inconvenience in consequence of it. It is most likely that the interval of the outbreaks depend upon the quantity of rain that may have fallen, as last year was remarkable for being very wet.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 27TH JANUARY TO 21ST FEBRUARY, 1842.

Six Months allowed for Enrolment.

John James Baggaly, of Sheffield, seal engraver, for "*improvements in combs for the hair, and which are also applicable to combing other fibrous substances.*"—Sealed January 29.

Joseph Hughes, of Whitehall Mill, Chapel-le-frith, Derby, paper maker, for "*improvements in the method or process of manufacturing paper.*"—Jan. 29.

James Hunt, of Whitehall, gent., for "*improvements in the manufacture of bricks.*"—Jan. 31.

Charles Wye Williams, of Liverpool, gent., for "*improvements in the making and moulding of bricks, artificial fuel, and other substances.*"—Jan. 31.

Henry Fowler Broadwood, of Great Pulteney-street, Golden-square, Esq., for "*an improvement in that part of a pianoforte, harpsichord, or other the like instrument, commonly called the name board.*"—Feb. 2.

William Newton, of Chancery-lane, civil engineer, for "*improved apparatus to be adapted to lace-making machinery, for the production of a novel description of elastic fabric from silk, cotton, woollen, linen, and other fibrous materials.* (A communication.)—Feb. 8.

Adderley Willcocks Sleigh, K. T. S. of Manchester, captain in Her M. F. Majesty's service, for "*a certain method, or certain methods of effecting and forming sheltered floating harbours of safety, by the employment of certain buoyant sea barriers, applicable thereto, and which said improvements are also applicable to, and useful for, the formation of breakwaters, floating bridges, light-houses, and beacons, the protection of pier-heads, embankments, and for other similar purposes.*"—Feb. 8.

Charles Hancock, of Grosvenor-place, artist, for "*improvements in printing cotton, silk, woollen, and other stuffs.*"—Feb. 8.

Benjamin Biram, of Wentworth, Yorkshire, Colliery viewer, for "*improvements in the construction and application of rotary engines.*"—Feb. 8.

Frederick Harlow, of Rotherhithe, carpenter, for "*improvements in paving or covering roads and other surfaces, and in machinery for cutting the material to be used for those purposes.*"—Feb. 9.

Isham Baggs, of King's square, Middlesex, chemist, for "*improvements in obtaining motive power by means of carbonic acid, and also by a peculiar application of heated air.*"—Feb. 9.

Christopher Nickels, of York-road, Lambeth, gentleman, for "*improvements in the manufacture of plaited fabrics.*"—Feb. 10.

William Brook Addison, of Bradford, in the county of York, manufacturer, for "*improvements in machinery for spinning worsted and woollen yarn.*"—Feb. 10.

George Jarman, of Leeds, flax and cotton spinner, Robert Cook, of Hathersage, Derby, heckle and needle manufacturer, and Joshua Wordsworth, of Leeds aforesaid, machine-maker, for "*improvements in machinery for spinning flax, hemp, and tow.*"—Feb. 14.

James Andrew, of Manchester, manufacturer, for "*improvements in the method or process of preparing or dressing yarns or warps for weaving.*"—Feb. 15.

Charles Thomas Holcombe, of Bankside. Southwark, iron merchant, for "*certain improvements in the manufacture of fuel, and in obtaining products in such manufacture.*"—Feb. 15.

John Osbaldeston, of Blackburn, Lancaster, metal heald maker, for "*improvements in looms for weaving.*"—Feb. 15.

Alexander Rousseau, of the Strand, manufacturer, for "*improvements in fire-arms.*" (A communication.)—Feb. 15.

George Haden, of Trowbridge, Wilts, engineer, for "*improvements in apparatus for warming and ventilating buildings.*"—Feb. 15.

John Lewthwaite, of East-street, Manchester-square, engineer, for "*improvements in steam-engines and boilers.*"—Feb. 15.

Thomas Russell Crampton, of Lisson-grove, engineer, and John Coope Haddan, of Moorgate-street, civil engineer, for "*improvements in steam-engines and railway carriages.*"—Feb. 15.

Robert Wornum, of Store-street, Bedford-square, pianoforte maker, for "*improvements in the actions of pianofortes.*"—Feb. 15.

Daniel Greenfield, the elder, of Birmingham, brass-founder, for an "*improvement in the manufacture of hollow metal knobs for the handles of doors, and other locks.*"—Feb. 21.

Moses Poole, of Lincoln's-inn, gentleman, for "*improvements in treating, refining, and purifying oils and other similar substances.*" (A communication.)—Feb. 21.

TO CORRESPONDENTS.

We have received a letter from Messrs. Braithwaite, Milner, and Co., in which they state that the apparatus for disconnecting the paddle-wheels of steam vessels is the invention and patent of Mr. Trewhitt. They have also favoured us by a corrected drawing, showing the connection of the apparatus with the crank and the engine, which we shall insert next month, together with a communication on the same subject from Mr. Grantham.

The suggested improvement of Amicus Machinarum, *on Messrs. Maudslays and Field's annular cylinder engine, by placing the air-pump in the central space will not do; the very object for which the annular cylinder was contrived, being for the purpose of getting a long connecting rod, is entirely lost in A. M.'s arrangement.*

Δ. *will be noticed next month.*

The communications on pile-driving are again deferred, as we have not as yet come to any satisfactory conclusion as to the actual force of the ram.

B. R. We do not consider the apparatus for preventing accidents on railways would answer the purpose supposed by its inventor.

Agricolz.—We will endeavour, in some future number of the Journal, to give a table showing the variation of the Magnetic Needle yearly.

The Gorgon Engines.—We have received two communications in answer to "Vulcan," which we regret, on account of their importance, we are obliged to postpone until next month.

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, III, and IV, may be had, bound in cloth, price £1 each Volume.

THE NEW YORK
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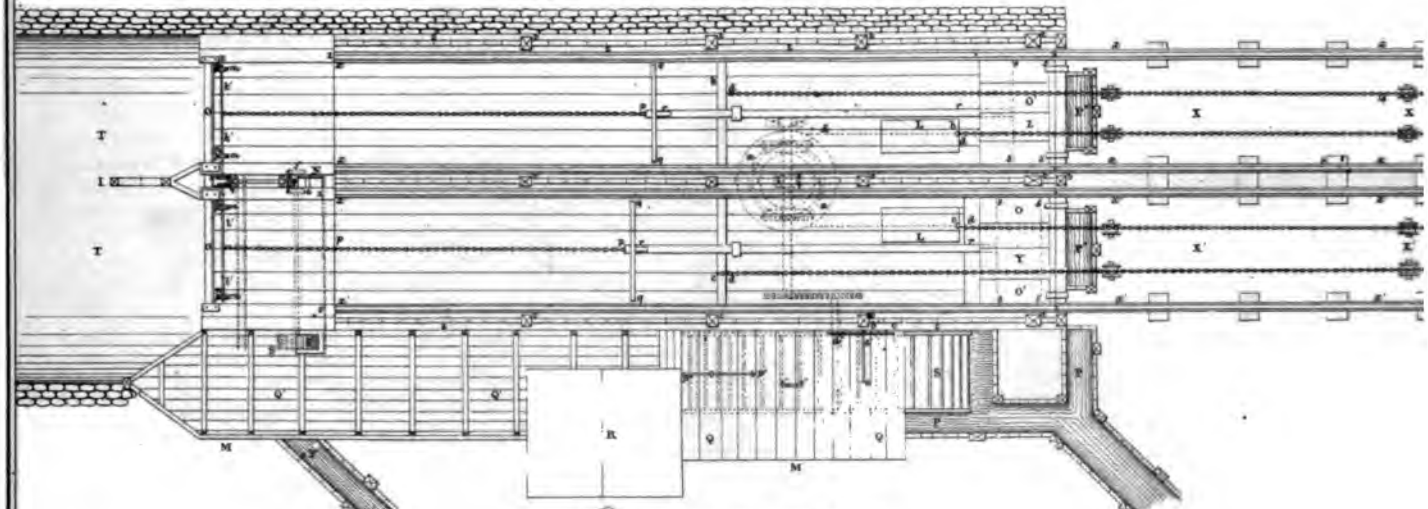
ASTOR, LENOX AND
TILDEN FOUNDATIONS

INCLINED PLANE, OF THE MORRIS CANAL, U. S. AMERICA.

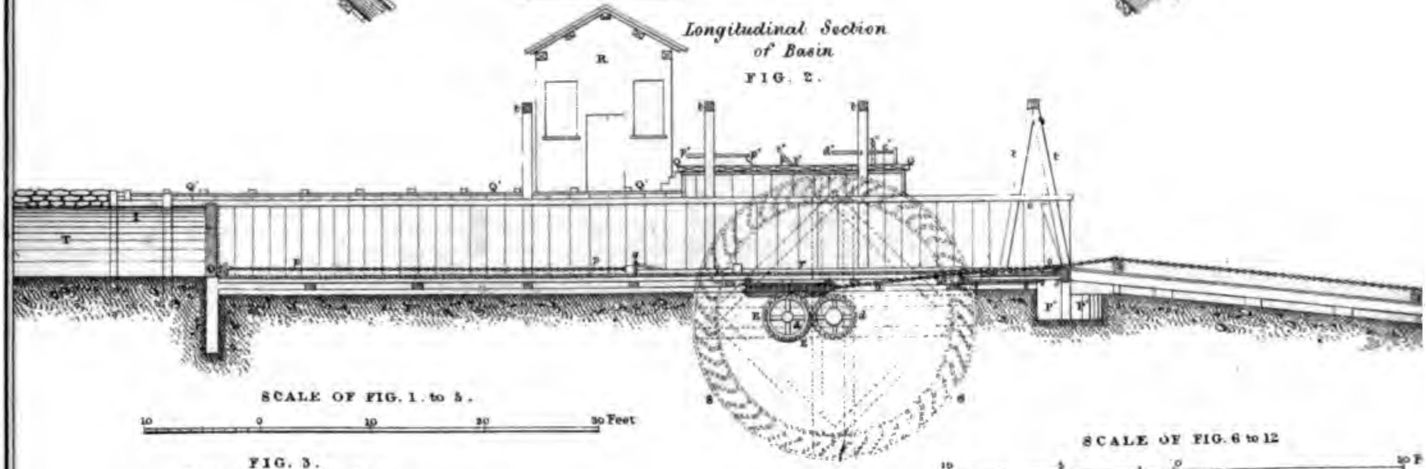
Plan of Chamber

FIG. 1.



Longitudinal Section of Basin

FIG. 2.



SCALE OF FIG. 1. to 5.

10 0 10 20 30 Feet

SCALE OF FIG. 6 to 12

10 5 0

FIG. 3.

Transverse Section.

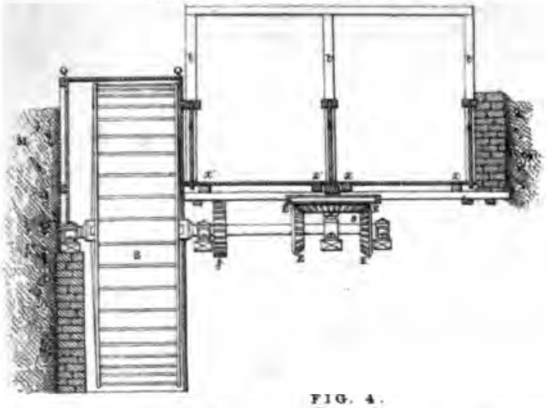


FIG. 6.

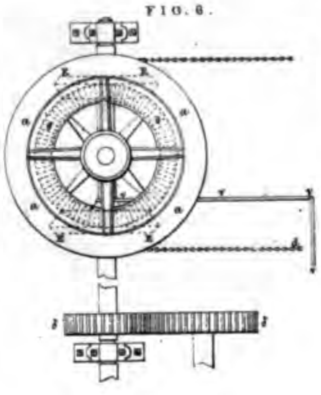


FIG. 7.

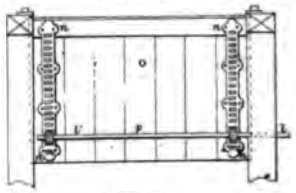


FIG. 8.

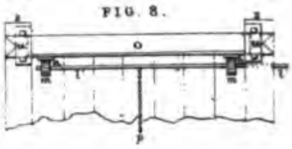


FIG. 4.

Truck

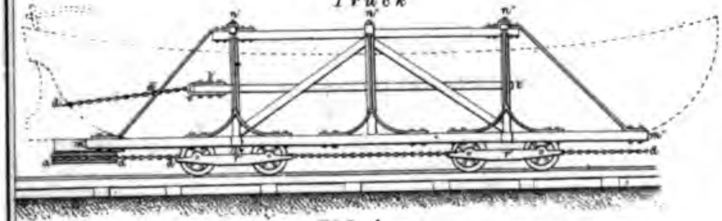


FIG. 5.

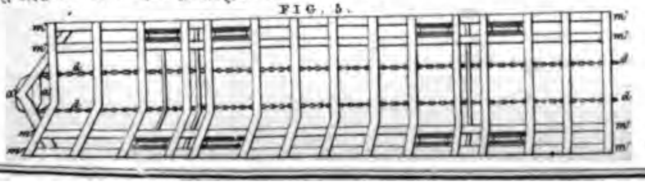


FIG. 11.

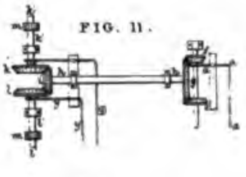


FIG. 12.

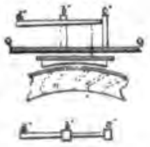


FIG. 9.

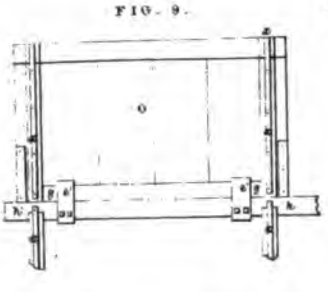


FIG.

THE INCLINED PLANES OF THE MORRIS CANAL, NEW JERSEY, UNITED STATES.

(With an Engraving, Plate IV.)

This canal is situate in the county of Morris, through the principal part of which it passes, and connects the two important rivers the Delaware and the Hudson. It is chiefly used for the transport of anthracite coal, which abounds in the Pennsylvanian mountains, to New York and other states. It was commenced in the year 1825, and finished in 1836, when it was opened. The construction is a work of considerable magnitude; it is in length 101 miles, and passes over an immense elevation of country, the summit being upwards of 914 feet above the Hudson, and 760 ft. above the Delaware. To overcome this great elevation, it would have been necessary to have had at least 200 locks, a number that would have occasioned great delay in the transit; it was therefore deemed advisable to have recourse to another mode of conveying the boats on those levels where there was a considerable acclivity in the section; for this purpose inclined planes were adopted, having an inclination, on the average, of one in 11, upon which are laid tram-ways for transporting the boats on trucks from the lower level to the upper level.

To show the magnitude of the work, we will give a few particulars of its construction. There are 18 locks on the Hudson side, having a total rise of 166 feet, and 7 on the Delaware side, 69 ft. rise; the locks are cased with stone, and are 78 feet long and 9 feet wide. Besides, there are 23 inclined planes, 12 on the Hudson side, total rise 748 ft., and 11 on the Delaware side, 691 ft. rise, there are also four flood gates at its junction with the two rivers, 5 dams, 30 flashes, 200 bridges, and 12 aqueducts, one that passes over the "Passaik" is of stone with an arch 80 feet span, and another of wood over the Pompton, 236 ft. long. The breadth of the canal at top is 32 feet, at bottom 20 ft. and in depth 4 ft. The works were first commenced under the direction of Capt. Beach, and afterward undertaken by Major Douglass, formerly Professor of the Military Academy at West-Point, who executed the inclined planes. One of the inclines 54 ft. high, cost 17,000 dollars, which is at the rate of 315 dollars *per foot high*.

We will now proceed to describe the inclined planes and the machinery, the object of our present notice:—

At the top of the inclined plane two chambers or locks are constructed of stone (figs. 1, 2, and 3) into which the boats are conveyed for the purpose of being lowered, or for their reception after they are drawn up; the upper end is divided from the canal T, by gates O, (figs. 7 and 8,) and the lower end by the gates O; the upper gates are opened and closed by the aid of a small water wheel S′, whose axis is prolonged and passes under the floor of the chamber to the partition N, and then turns two bevelled cog-wheels, e, f, each twelve inches diameter (see fig. 11); by the aid of a lever these wheels may be made to turn in either direction, they work into another bevelled wheel at right angles, which transfers the motion to the bevelled gear i, at the other end of the axis h, which also turns in either direction the two bevelled wheels k, l, upon the axes l' of these two wheels are small pinion wheels m, which work into the racks n on the face of the gate, and raise or lower the gate as may be desired. The gates O′, (figs. 9 and 10,) at the other end of the chamber open upon a horizontal hinge joint, when open it lies flat upon the floor, and when shut it rests against the slanting pieces or stops o. For the purpose of filling the lock, the upper gates are lowered, which allows the water to flow over the floor of the chamber, and lift the lower gates, and as the water rises, so the gates are closed; when the lock is emptied, as the water lowers, so the gates O′ drop down on the floor.

The emptying of the chambers is effected in the following manner: On the back of the upper gates are axles k' and l', to which a chain p is attached, and fastened at the other end to a moveable board, g, ten inches high, connected to a bar r, attached to a horizontal sluice s, and in the floor of the chamber, which covers the outlet, P. If the upper gate O be raised, it prevents the water of the upper level flowing in, and at the same time the chain p is coiled round the axis l', and consequently the board g and the sluice s are drawn forward, and a communication opened to the channel below P″, through which the chamber is emptied. When the upper gate o is lowered, the water rushes over, and by its force pushes forward the board p, and therewith the horizontal sluice s, and closes the aperture, at the same time closing the lower gates.

The machinery for moving the boats is under the floor of the chamber, and is set in motion by the aid of an overshot wheel (S, figs. 1, 2, and 3) 26 feet diameter, and 8 feet broad, made of wood, with a cast-iron shaft; upon this shaft is a cast-iron pinion wheel d, five feet diameter, which works into a cog-wheel d', 4 feet diameter; upon a prolonged axis of this last wheel are two bevelled cog-wheels, 5 feet diameter, E E′, (shown more at large in fig. 6) by means of the lever arrangements, either of these wheels may be made to revolve either way, as may be required to turn the horizontal cog-wheel θ, 7 feet diameter, the axle of which is under the centre wheel that divides the chambers; upon the top of this horizontal wheel is fixed the pulley 9 feet diameter a, round which the chain d passes, for the purpose of raising or lowering the truck.

Upon the inclined plane X X′ are laid two pair of rails x, x', $3\frac{1}{2} \times 1$ for the trucks to travel upon, and in the centre of each truck way is a pair of guide-pulleys, upon which the chain d runs.

For the purpose of conveying the boats there are two trucks (figs. 4 and 5 are a plan and elevation of one of them), the framing rests upon four longitudinal bearers m'' upon which are laid 15 transverse bearers; on each side there are three vertical standards n'', fixed above by cross-stays n, and below by bolts and iron stays. They are supported upon four pairs of wheels, two pair r' are placed close to each other, and have in the centre a moveable axis, upon which the trucks can turn; at the end is a horizontal wheel a, round which the draw-chain d passes. When it is required to convey a boat from one level to another, it is generally done by having one truck at the top of the incline, in one of the chambers, and another at the foot in the lower level of the canal, the trucks stand in the water, and the boats are floated over and secured to them by a chain d' to the side-bar t. The boats are then drawn up by the aid of a strong chain d, (figs. 1, 2, and 3,) fastened at one end at b, and at the other at a, to a, sills fixed to the floor of the chambers, from b it passes down one side of the inclined plane X between the rails, then round the pulley a', attached to the end of the truck, thence up again between the same rails to the chamber, where it passes through the floor L at b, to the underside, round the horizontal pulley a, and emerges again at c, it then passes down the other truckway X′ round the pulley a' of the truck, up again, and terminates at c', where it is fixed to the sill; thus when the truck is descending the chain is lengthening, and at the same time it is shortening with the ascending truck; by this arrangement the trucks nearly balance each other, and the only work for the water-wheel is to overcome the friction and the small difference in the weight of the up and down truck. There is also another help-chain fastened to the side of each truck, and which passes down the centre of the railway, over guide-pulleys, round a pulley at the foot of the incline-plane, which is for the purpose of drawing the ascending trucks up to the end of the chamber; as by the winding apparatus the ascending truck is only just brought to the top of the incline.

Fig. 12 shows the lever and break for regulating the speed of the water-wheel.

The boats weigh from seven to eight tons, and carry from 20 to 30 tons, the time occupied in passing up the longest incline of 1100 feet in length and 100 feet rise, is stated to be fifteen minutes, including stoppages. On account of their shorter length, the boats are not so long in passing over the other inclines. It is generally reckoned that about six boats can pass each way per hour. The machinery can be managed by a single person, the boatman having nothing to do but to fasten the boat on to the truck.

MEASUREMENT OF BRIDGES.

Sir—Will you allow an old friend to ask, through the medium of your very able Journal, some of your very valuable correspondents the best method of measuring a stone bridge? taking the different parts of the works separately, and you will much oblige,

Yours very sincerely,

Dublin, March 12, 1842. Petrus.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXXVI.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. IT would seem that architects neither keep any journals, nor carry on any correspondence relating to their professional pursuits and engagements, for nothing of the kind has at any time been communicated to the public, not even as regards such men as Adam, Wyatt, and many others whose intercourse with the higher ranks of society must have given some sort of historical interest to their epistolary correspondence, supposing they ever wrote any letters not strictly confined to mere matters of business. While Joey Grimaldi the pantomime clown obtains a biographer who bestows upon him a couple of volumes, Sir Jeffry Wyatville has not been thought worthy of any such compliment, notwithstanding that he was for some time within the sphere and atmosphere of a court, and that a life of him would, no doubt, serve as an excellent peg on which might be hung numerous anecdotes relating to very distinguished personages, including the conversations which he must no doubt have held from time to time with his royal patrons on the subject of architecture. Some day or other, perhaps, the world will yet be enlightened, and some fortunate publisher will be able to announce the "Wyatville Papers and Correspondence."

II. It is excessively provoking to meet so repeatedly with paltry "put-off" excuses for reticence of criticism in regard to contemporary works of architecture, as though they were not just as much amenable to opinion and comment as the productions of any other art, but were entitled to especial forbearance. It is after such fashion that Gauthier apologizes for not offering any remarks on the design of the new theatre at Genoa (erected by Carlo Barabino, 1826-8), saying he chooses "to abstain alike from commendation or from censure, leaving it to the public to appreciate its merits"! Leaving it to the public, forsooth!—and how is the public to form its judgment if critical inquiry is to be stifled, and those who are, or who ought to be, capable of delivering opinion on such matters, abstain from doing so? Without any great breach of charity, we may, in all such cases, attribute the apparent candour and forbearance either to the writer's having no real opinion of his own to express, either one way or the other, or to a ridiculous excess of cautiousness. Why there should be aught more invidious or indelicate in criticising the productions of a living architect, than in exercising the same freedom of judgment on those of a living painter or poet, it is not easy to perceive. Criticism may knock a poem on the head at once, and cause it to drop dead from the press—but criticism cannot knock down stone walls; a building will remain either to confirm, if correct, or refute, if unjust, the opinion passed upon it. It must be allowed that architectural critics are liberal enough in favouring us with established opinions, which may be come at without other trouble than that of copying them from other books, and which are most conveniently safe, inasmuch as the *critic* himself hazards nothing, for if the opinion be approved, he can take the credit of it, and if taxed as unsound, can throw the odium of it on the stupidity of those from whom he borrowed it. "But," exclaim some, "we do not want criticism—we have gone on very comfortably without it. Criticism does far more harm than good; it teaches the public to pry into what they have no business to fancy they can understand, whereas all that we require of them is their implicit admiration."

III. Though we have had many modern architectural works relative to the principal cities of Italy, they have all of them been exclusively retrospective or nearly so, exhibiting only the monuments of former periods of the art, and showing scarcely a single recent example. Admitting that the subjects selected for them are of more intrinsic value as studies than any buildings of recent date, still some of the latter would at least possess the interest of novelty. Architecture is not absolutely defunct in Italy, although it might almost be imagined that it had not produced a single work of any note since the commencement of the present century, so little is the information to be met with relative to any edifices that have been erected there within the last forty or fifty years. It would seem to be an express rule adhered to by all our tourists, architects, and artists, who visit that country, *not* to take any notice of contemporary buildings—on no account to describe or to delineate them, but to bore us for the ten-thousandth time, with their extacies, with the Pantheon, and St. Peter's, with Palladio and Michel Agnolo. If they can bring home nothing less stale, they would do well neither to take up their pens nor open their mouths. Of Cagnola they of course have never heard, Possagno they have never visited, nor have they ever stumbled upon the Café Pedrocchi at Padua—a palazzo in appearance, and a sufficiently striking specimen of the modern Greco-Italian school—with much elegance to recommend it, though not free from defects. Although it may not be ranked among the public edifices of that city, it is, as a piece of architecture, quite as conspicuous an object as the Reform Club House, which last, perhaps, a tourist through Pall Mall would not have eyes to discover. A work containing examples of the Italian architecture of the present century, would be a welcome novelty, and though the buildings themselves may be comparatively few and far between, still, ample materials for the purpose are to be collected between Milan and Naples, from the structures by Bianchi and Niccolini, in the last mentioned city, to Buonsignore's church, the Madre di Iddio, at Turin, and Canova's Doric rifacciamento of the Pantheon, at Possagno. But ———! and that, if not the most satisfactory, is certainly a most omnipotent reason wherefore nothing of the kind either is, or is likely to be undertaken.

IV. That theory which would base architectural beauty upon *utility* and *fitness*, is so far from being satisfactory as clearly tracing the source of the former quality to the two latter, that, instead of removing perplexity, it rather increases it. In direct opposition to such doctrine, every-day experience convinces us that so very far from constituting æsthetic beauty, mere utility and fitness contribute very little at all towards it, even in architecture, where, as far as the purpose of building is concerned, they might seem to be not only indispensable, but all-sufficient, and afford all the pleasure which the mind can derive from examining and contemplating edifices of any kind. Yet such is assuredly not the case; on the contrary, it is only when it aims at something more than utility, when it indulges in the superfluous—or, if you will, the useless—in short, when it steps into the province of art, and aims at the IDLE gratification of the eye, that architecture is entitled to the high distinction claimed for it, and the lofty pretensions set up in its behalf. Upon the utility principle of beauty, a turnip field would be a far more agreeable prospect than any to be met with in Swiss or Italian scenery; and upon the common-sense fitness and utility principle, a modern church erected according to the "cheap and nasty" system, and according to Islington or Bethnal Green taste, ought to delight quite as much as, if not more than, any of those glorious examples of our ancient ecclesiastical architecture which so wonderfully impress the mind. Unless the word "*utility*" be exceedingly elastic, indeed, and its meaning so ductile that it may be drawn out like gold to a most prodigious extent, utility cannot at all be said to recommend the dome of St. Paul's, it adding nothing whatever to the serviceableness of the building; while on the other hand, the unsightly platforms or galleries with which our churches are encumbered, ought to be accounted beautiful, since they certainly have the plea of being useful, as far as affording sittings goes.

V. What a writer in the Art Union has remarked relative to works of sculpture exhibited in this country, will apply equally well to architecture. "The last slight which this noble art sustains remains untold; see our daily and weekly papers, nay, our journals of *art* and science, see the column after column noticing the productions of the pencil, and the *infantile* paragraph, stating simply that sculpture too is there." By merely changing a single word, and reading "architecture," or "architectural drawings," instead of "sculpture," we have here described the sort of attention bestowed by the critics of the periodical press upon exhibited designs. Opinions as to their merit they do not put forth, since they are unable either to form or to express any; but it is considered quite sufficient if the "infantile paragraph" be tacked on to the rest, by way of postcript in some such terms as "there are several beautiful architectural drawings, on which our space will not permit to bestow more particular notice." Or else "particular notice" goes to the extent of copying titles and names from the catalogue, ticketed, perhaps, by some luminous epithet, which leaves us just as much in the dark as ever with regard to the things so mentioned. For this neglect, architects have, in a great measure, to thank themselves; first, for presenting their designs before the public at the fag end of an exhibition of pictures, thrust into a little poking room where not above one third of the drawings hung up can be seen, much less examined. Secondly, because they do nothing whatever towards promoting a popular relish for the study of architecture, and vindicating the pretensions assumed for it as one of the fine arts. They at least have not much right to complain of their designs being passed over without notice at exhibitions, when, by the kind of notice they themselves generally bestow upon them in their own publications, they convince us that they are unable to explain their own ideas, or point out the effect and character at which they aimed. Ill does it become architects as a body to regret that there should be so much apathy on the part of the public towards their art, when they themselves display a degree of apathy still more unaccountable if not very much more discreditable.

MESSRS. MAUDSLAYS AND FIELD'S MARINE ENGINES.

It must be unnecessary to offer a single observation upon the value of the annexed table. Its value will, we are confident, be fully appreciated by our readers.

It is proper to remark, that several of the sizes not given directly in the table are involved in other sizes which are given, and may be deduced from them by a very simple process. Thus the length of the stroke of the air pump, as well as of the hot water or feed pump, are not given directly, but may at once be ascertained as follows:

Given—Length of stroke of cylinder.
" Distance from centre of beam gudgeon to centre of cylinder.
" Distance from centre of beam gudgeon to centre of air pump.

From these data the length of the stroke of the air pump may easily be obtained; we have only to work this simple rule of three question;—Distance from centre of beam gudgeon to centre of cylinder is to distance from centre of beam gudgeon to centre of air pump, as length of stroke of cylinder is to length of stroke of air pump: whence we obtain the answer sought for at once. It is manifest that the answer may also be obtained by construction. The feed pumps are, in Messrs. Maudslays' engines, as well as in most other engines, worked off the air pump cross head; the length of the stroke of the air pump, therefore, determines the length of the stroke of the feed pump.

The sizes given in the table have manifestly reference only to side lever engines. The size of the steam pipe is not given in the table, but the size of the steam port is, and the steam pipe should be, about the same area. The quantity of lap or cover proper to be put upon the valve, is a question determinable altogether by the quantity of expansion required, and varies in different engines of the same power. But the upper and under faces of the valve are, in Messrs. Maudslays' engine, in no case of the same breadth: the cause for this inequality is that if the valve be at half stroke, that is, with both ports closed, and if the engine be moved round, the travel of the valve from half stroke to the extremity of the stroke *downwards* will be found to be not the same as the travel of the valve from half stroke to the extremity of the stroke *upwards*. In other words, the space described by the valve whilst the piston descends, and the space described by the valve whilst the piston ascends, *are not equal;* whereby it becomes necessary to make the superior and inferior faces of the valves of different depths, to compensate for this inequality.

The accuracy of the preceding statement every engineer has it in his power to verify, either by a model, or by a drawing of the valve and piston in their several relative positions. The cause of the irregularity may be traced to the oblique action of the connecting and eccentric rods. If the piston be placed at half stroke, that is, midway between the top and the bottom of the cylinder, the crank will not be level. This is manifest from the ordinary method of ascertaining the length of the connecting rod, which is to level the beams, and take the vertical distance from the extremity of the beams to the centre of the crank shaft. When the beams are level the engine is at half stroke, but if we wish to attach the connecting rod to the crank pin—its length being ascertained as above—it will be necessary to bring the crank down a little, to compensate for the depression of the head of the connecting rod due to the deviation from the vertical line. If, then, the crank be not level at half stroke, the descent of the piston from half stroke, and its ascent to half stroke again will accomplish *more* than half a revolution of the paddle wheels; and the ascent of the piston from half stroke, and its descent to half stroke again, will accomplish *less* than half a revolution of the paddle wheels. The ratio of the disparity will vary with the length of the connecting rod, the circumstance of there being overhang or no overhang of the beam, the length of the beam, and other circumstances; but in all ordinary engines, the difference between the upper segment of the circle of the crank's revolution and the under segment of that circle will interfere with the valves' motion, and the proportionment of the valve faces ought to have reference to the extent of that interference.

It is Messrs. Maudslays' practice, in some of their very recent engines, to make the stroke of the valve considerably more than twice the depth of the port. All the valve levers are equal, and the stroke of the valves is in all cases equal to the throw of the eccentric. It is also their invariable practice, in all engines of considerable magnitude, to construct the valve casing with a faucet joint, to permit the expansion of the casing when heated with steam, without distorting the cylinder. In some large engines which have been without this provision, we have known the cylinder ports to be rent asunder by the expansion of the casing; and however frequently and however well the rust joints of the casing might have been made, they invariably became very soon leaky, from the effect of unequal expansion. The cylinder when hot will expand as much as the valve casing; and if the two were always equally heated, no detriment could ensue from the absence of an expansion joint. But as the throttle valve is never perfectly tight, and as the slide valve generally is so, the steam before the engines are started enters the casing and induces its expansion; whilst being excluded by the slide valve from the cylinder, the cylinder is not heated, and therefore does not expand. Injury of some sort or other, if the engine be large, is sure to be the result of these conflicting forces. Our provincial engineers are sadly deficient in their acquaintance with or their attention to details such as those to which we have adverted; yet it is upon an attention to such details that the superiority of an engine principally depends.

In the double cylinder engines of the Messrs. Maudslays, cylindrical slide valves are employed, and have been found to operate extremely well. The packing of these valves is metallic. The packing of the pistons made by the same firm are invariably metallic, and generally consist of a single ring turned eccentric, cut in one place, and the cut part fitted with a tongue piece to prevent the steam from passing through the cut. A piece the same breadth as the ring is fitted over the back of the cut, ground tight, and then rivetted to one part of the ring. The elasticity of the ring is in most cases found sufficient to keep the ring in intimate contact with the interior of the cylinder, and the force with which this contact is maintained may be either augmented or diminished by a bridle—a truly ingenious contrivance, and one which we regret the limits of this notice prevent us from referring to more specifically.

In a future paper we shall probably enter with considerable minuteness into the merits of Messrs. Maudslays' machinery, or rather into those details which constitute the excellence of the machinery of that eminent firm.

T 2

PROPORTIONS OF MARINE ENGINES.

The following Table of Proportions is collected from Marine Engines of Messrs. Maudslays' manufacture.

Horse Power	10		15		20		25		30		40		50		60		70		80		100	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
Cylinder, diam. inside		20		24		27		29½		32		36		40		43		46½		47½		53
Air-pump, diam. inside		11½		14		16		17		18		21½		24		24		28		28		31
Slides, diam.		9		10¼		11½		12¾		13¼		15		17½		17½		21		21		22¾
Hot water pump, diam.		2¼		2½		3		3¼		3½		4		4½		4½		5½		5½		6½
Injection cock, diam.								1¾		2		2⅛		2½		2½		3		3		3
Feed pipe, diam.				1½										2½		2½		2½		2½		
Hand pump, diam.		4		4		4		5		5		6		6		6		6		6		6
Crank shaft, diam.		4½		6		6½		7		7½		8		9		10		10½		10½		12
Piston rod, diam.		2		2⅜		2¾		3		3¼		3½		4		4¼		4½		4¾		5¼
Air pump rod, diam.		1¼		1¾		2		2¼		2¼		2¾		3		3		3½		3½		3⅞
Cylinder side rod, diam.		7½ 1/16		1¾		2		2¼		2½		2¾		3		3¼		3½		3½		3¾
Air-pump side rod, diam.		1		1⅝		1½		1½		1½		1¾		1⅞		1⅞		2⅛		2⅛		2⅜
Slide rod, diam.		¾ 1/16		¾ 1/16		⅞		1		1⅛		1¼		1½		1½		1⅝		1⅝		1⅞
Beam gudgeon, diam.		4½		6		6		7		7¼		8		9		9		10½		10½		12
Beam ends, diam. pins		2		2⅜		2¾		3		3¼		3½		4		4¼		4½		4½		5¼
Air pump pins in beam, diam.		1¼		1⅝		1¾		1⅞		2		2¼		2½		2½		2⅞		2⅞		3⅛
Length of stroke of cylinder	2		2	3	2	6	2	9	3	0	3	6	4	0	4	0	4	6	4	6	5	0
Beam at centres, diam.	1	2¼	1	6	1	7	1	9	1	11	2	1	2	4	2	4	2	9	2	9	3	0
Beam near centre, depth		10½		11¼		12½	1	2	1	3¼	1	4	1	6¾	1	7	1	9¾	1	9¾	2	0
Beam at ends, depth		5		6⅜		6¾		7½		8		8¾		10		10¼		12		12	1	2
Beam at ends, diam.		6		7¼		8		9		9½		10½		12	1	1	1	2	1	2	1	4
Boss of beam, centre length		5		6		6		6		6½		7¼		8		8		10½		10½		12
Air-pump boss of beam, diam.		2⅝		3⅜		3⅛		3¾		4		4½		5		5		6¼		6¼		7
Air-pump boss of beam, length		1¾		2¼		2½		2¾		3		3¼		3½		3¾		4¼		4¼		4¾
Centre boss of beam, diam.		8¾		11		11½	1	1	1	2	1	3	1	5	1	5	1	1	1	8	1	10
Beam, thickness of		1		1⅛		1 5/16		1⅜		1½		1¾		1⅞		2		2¼		2¼		2 3/16
Centre of beam to centre of parallel motion		8½		9¾		10½		11⅜		12½	1	2⅞	1	5	1	4⅞	1	6½	1	6½	1	8¼
Cylinder cross head, depth of boss		6		7½		8		9		9½		10½		12	1	1	1	2	1	2	1	3½
Cylinder cross head, depth of middle		4⅞		5½		6¼		7		7½		8½		9½		10¼		11½		11½	1	1
Cylinder cross head, thickness		1½		1⅝		1¾		2 1/16		2¼		2½		2¾		3		3¼		3¼		3¾
Cylinder cross head, diam. of boss		4		4½		5		5⅝		6		6¾		7½		8		8¾		9		10
Air-pump cross head, depth of boss		4½		5		5½		6½		6¾		8		9		10		10½		10½		11½
Air-pump cross head, depth of middle		3½		4		4½		5		5¼		6¼		7		8		8		8		9
Air-pump cross head, thickness		1		1⅛		1 5/16		1 7/16		1½		1⅝		2		2		2¼		2¼		2½
Air-pump, centre to centre, side rods transversely	2	5½	2	10¼	3	1¼	3	3½	3	6¼	3	11½	4	5	4	7¾	5	0¾	5	0¾	5	8½
Air-pump cross head, diam. of boss		2 9/16		3⅜		3½		4		4		4⅝		5⅛		5¼		5¾		5¾		6½
Steam port, length		7½		8¾		10		11		11½		13		15		18½		18½		18½		20
Steam port, breadth		1½		1¾		2		2¼		2⅝		2¾		3		3		4		4		4½
Slide, motion of		4½		5		5½		6		6½		7¾		8¼		8¼		11		11		12½
Crank centre, height	4	8	6	0	6	6	6	6	7	7	8	9	10	0	10	0	11	2¼	11	2¼	12	4
Beam centre, height		7½		7¾		8		9		10		14		16		16		18		18		20
Centre of beam gudgeon to centre of crank	2	10	3	3	3	7½	3	10½	4	3	4	11	5	8	5	8¾	6	5½	6	5½	7	2¾
Centre of beam gudgeon to centre of cylinder	2	9	3	1¾	3	6¼	3	9	4	1⅜	4	9	5	6	5	6⅝	6	3	6	3	7	0
Centre of beam to centre of air-pump	1	4½	1	7	1	9	1	10½	2	0½	2	4½	2	9	2	9¾	3	1½	3	1½	3	6
Height of parallel motion centre from sleepers	3	10¼	4	2½	4	7⅛	5	0½	5	4¾	6	1¾	6	11¾	6	11¾	7	9⅝	7	9⅝	8	6
Centre of slide rod from slide face		2		2⅛		2¼		2⅝		2¾		3⅜		3⅝ 1/16		3⅝ 1/16		4½		4½		5
Centre to centre of beams transversely	2	9	3	3	3	6½	3	9	4	0	4	6	5	0	5	3	5	9	5	9	6	6
Centre to centre of frames transversely	1	7	1	11	2	1½			2	3			2	10	2	10	3	4	3	4	3	8
Centre to centre of engines transversely	5	6	6	0	6	4	6	8	7	0	7	4	8	0	8	4	9	0	9	0	10	6
Height of condenser from sleepers			1	2			1	5	1	6			1	11½	1	11½	2	2½	2	2½	2	3
Centre of beam gudgeon to front of condenser				10¾				11⅜	1	1			1	6	1	6¾	1	8½	1	8½	1	11
Centre of beam gudgeon to back of condenser				4¼				7¼		8			1	0	1	0	1	1½	1	1½	1	3
Condenser, width			2	8½			3	2½	3	5			4	3½	4	6½	4	10	4	10	5	5½
Eduction pipe, depth				10¾				11	1	1			1	4	1	4	1	5½	1	5½	1	7¾
Condenser, thickness				¾		¾		¾		¾				1		1		1¼		1¼		1½
Foot valve passage, depth				2				2		2				4		4		5		5		6
Foot valve passage, width			1	2			1	5	1	6			2	0	2	0	2	4	2	4	2	7
Columns, diam. of top		4		4¾		5¼		5⅛		6		7		8		8		9⅛		9⅛		10
Columns, diam. of bottom		4½		5½		6¼		6⅜		6¾		8		9		9		10½		10½		11½
Frames, thickness		½ 1/16		⅝		⅝ 1/16		¾		¾		⅞		1		1		1 3/16		1 3/16		1⅜
Centre to centre of columns in side frames	1	6	1	8½	1	11	1	11½	2	2	2	7	3	0	3	0	3	3	3	3	3	7½
Height of hand gear from sleepers	2	5¼	2	9	2	6½	2	10¼	3	1	3	1¾	3	5	3	5	3	9½	3	9½	4	2
Small columns, diam.		1⅞		2½		2⅝		2½ & 3		2⅝ ⅜		2⅞ 3½		3¼ 3⅞		3¼ 3⅞		3¾ 4½		3¾ 4½		4¼ 4⅞
Centre of crank to centre of parallel motion shaft	3	10	4	4¾	4	10	5	2½	5	8½	6	7½	7	8¼	7	8¼	8	7½	8	7½	9	6¾

DOUBLE CYLINDER STEAM ENGINE.

Description of a Double Cylinder Rotative Steam Engine, erected by MESSRS. G. and J. RENNIE, *at Mr. Thomas Cubitt's Factory, near Vauxhall Bridge.*

THIS engine is entitled to the attention of all who are interested in the economical production of steam power. For a rotatory engine its consumption of fuel is believed to be unprecedentedly small; and we are convinced we shall render an acceptable service to our readers by informing them of the peculiarities of its structure, and the nature of its performance.

The arrangement of the parts of the engine is identical with that of the beam rotative engines in common use, with the exception that the motion is derived from two cylinders instead of from one. The employment of two cylinders, the pistons of which are worked by the same steam, was first practised by Hornblower, and extended and improved upon by Woolfe; but the plan has never come into general use. In this engine the smaller cylinder is one-fifth of the capacity of the larger cylinder, and the expansion takes place in the larger cylinder exclusively. The steam enters the smaller cylinder direct from the boiler during the whole of the stroke; and having pressed down the piston, escapes, not into the atmosphere or into the condenser, but into the larger cylinder, where it becomes instrumental in forcing the piston of the larger cylinder upwards. The same steam, therefore, is rendered available in the production of power in both of the cylinders, and it is only after having accomplished this end that it escapes into the condenser.

The piston rods proceeding from the cylinders are attached to the same end of the beam, the rod of the larger cylinder at the extremity of the beam, and the rod of the smaller cylinder at a point nearer the main axis. The pistons, therefore, act in concert; and by a proper arrangement of the valves, a communication is maintained between the space beneath the piston of the smaller cylinder and the space above the piston of the larger cylinder, so that the pistons descend simultaneously.

The engine is supplied with steam by one boiler, which is cylindrical, and is, in its details, of the most approved Cornish construction. The exterior diameter of the boiler is 6 ft. 3 in., the extreme length 34 ft., and the pressure of the steam 28 lb. upon the square inch. The fire grate is situated in an internal flue tube, 3 ft. 8 in. in diameter, which extends through the boiler, from end to end. The length of the fire-place is 4 ft. 6 in., its breadth 3 ft. 8 in., and its mean height 18 in. The coal burned is Graigola, an excellent and economical species of Welsh coal, which produces no smoke. The depth of coals upon the fire bars is never permitted to exceed 3 inches, so that there is little or no carbonic oxide generated. The combustion is slow, a condition favourable to its perfection, and as the intensity of the fire scarcely exceeds that of a common household grate, there is no clinker formed. The fire bridge is composed of brick, and instead of being flat upon the upper surface, as is the case in many boilers, is formed to a circle nearly concentric with the circle of the flue tube, and leaving only a few inches of opening between the convex surface of the bridge and the concave surface of the flue tube. By this expedient the flame and hot air proceeding from the fire are spread in a thin sheet over the interior surface of the flue, by which means their heat is more rapidly and perfectly communicated to the water in the boiler.

Between the fire bridge and the farther extremity of the boiler a tube extends longitudinally through the flue. This tube contains water; it is about 25 inches in diameter, and communicates in two places with the water in the boiler. One of these communications is through a vertical pipe, extending from the under side of the flue tube to the under side of the horizontal pipe containing water, and situated immediately behind the bridge. The other communication is through a copper pipe at the after extremity of the boiler. This pipe is 3½ in. in diameter; it springs from the upper side of the horizontal pipe, and, passing to the outside of the boiler, ascends until it reaches the level of the boiler top, when, bending over, it penetrates the shell of the boiler, and descends internally until it reaches to the depth of a few inches below the water level. Through this arrangement of pipes a continual current of steam and water is maintained.

The hot air, upon leaving the furnace, travels through the internal flue, communicating its heat both to the water in the boiler and to the water contained in the horizontal pipe situated in the flue which we have just described. Upon arriving at the extremity of the internal flue, the current of hot air is separated into two streams, one of which traverses the one side of the boiler, and the other the other side of the boiler. These streams, upon arriving at the front of the boiler, again unite; they then descend, and pass longitudinally beneath the bottom of the boiler, after which they enter the chimney. In the passage which unites the flue beneath the bottom of the boiler with the chimney, a long pipe is placed about 15 inches in diameter, and into this pipe the water employed for feeding the boiler is first introduced. By this arrangement the air proceeding to the chimney is robbed of its superfluous heat, and escapes into the atmosphere at a comparatively low temperature.

The pressure of the steam in the boiler is indicated by a syphon mercurial gauge, graduated to feet, inches, and quarters of an inch. The level of the water in the boiler is regulated by a feed cock, adjusted from time to time by the engineer. The usual apparatus for feeding by a head of water, with a valve operated upon by a float, would require to be of inconvenient dimensions if applied to this boiler, on account of the superior pressure of the steam to that of ordinary land boilers. There is a glass gauge tube and the usual gauge cocks for the indication of the water level.

The boiler is furnished with two steelyard safety valves, and one safety valve situated within the boiler and inaccessible to the engineer. Four brick walls enclose the boiler, and a 9-inch brick arch extends over its top. Between this arch and the external surface of the boiler a space of an inch or two is left, to leave room for the expansion of the boiler. Above the brickwork there is a layer of charcoal about a foot in depth, for the purpose of preventing the escape of heat from the boiler; and the precautions adopted have the effect of rendering the escape of heat so trifling that it is nearly imperceptible.

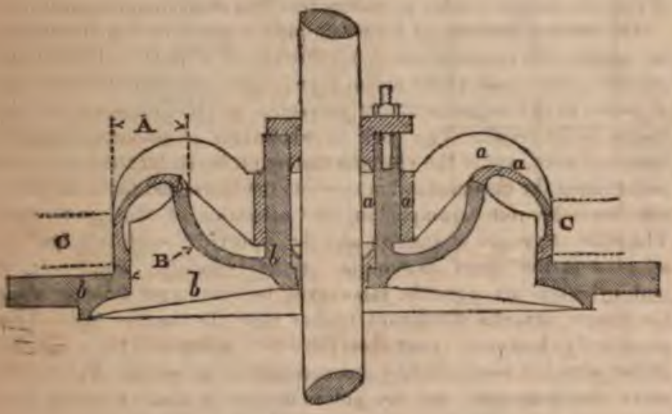
The interior diameter of the steam pipe is only 3 in. Upon stopping the engine, the eccentric rod is not thrown out of gear, as is the usual practice, but a cock in the steam pipe is shut, whereby the admission of steam to the engine is totally prevented, and the quiescence of the engine is the result. The cock by which this is accomplished is a four-way cock, one of the channels through it being for the purpose of maintaining the communication between the boiler and the slide valve, and the other for accomplishing the operation of *blowing through.* The slide valves are of the common three-ported description, and are situated at the upper extremities of the cylinders. The covers of both cylinders are upon the same level, but the larger cylinder being the longer projects downward further than the smaller one. This peculiarity, however, is not observable to a spectator: the symmetry of the work has been carefully and successfully preserved. The valves move simultaneously, and are put in motion by arms extending from stout iron rods, which ascend through the floor of the engine-room, and are guided in sockets attached to the respective cylinders to which the valves belong. These rods derive their motion from a cross head which forms the upper side of a square frame, in which a heart-shaped cam revolves, by which means the frame is moved alternately upwards and downwards, the sides of the frame being so far apart that the cam passes them in its revolution, without communicating any lateral motion. This arrangement has been long known under the name of *the heart motion*, but its extended employment has been prevented by the impression that it produced a jarring and irregular motion, unfavourable to the smooth working of machinery. This impression is, in the present case, proved to be unfounded: the valves are moved without noise, tremor, or harshness of any kind. The advantage to be derived from the use of the heart motion is a rapid opening and closing of the port; but we believe the eccentric to accomplish this operation with sufficient rapidity, if the ports be made of proper dimensions.

The cam is made of steel, and the upper and under surfaces of the square frame against which the cam presses are covered with plates of steel, about three-quarters of an inch in thickness. The cam is bolted upon a cast iron chuck, keyed upon the end of a horizontal shaft, about 3½ in. in diameter, which derives its motion from the main shaft of the engine, at the same point where the governor derives its motion. The square frame presses against this cast iron chuck, and is steadied by it.

The beam, parallel motion, connecting rod, crank, fly wheel, &c. are of the usual description, and therefore require no particular notice. The slide valves are, as we have already mentioned, of the description known as three-ported. There is a loss of steam from the use of this kind of valve. We consider a double two-ported valve to be in every respect preferable. The governor is supported by a frame placed immediately over the crank shaft, and the connection between it and the throttle valve is maintained by a rod which runs beneath the floor of the engine house. The diameter of the cold water pump is 10 in.; the length of its stroke 2 ft. 5½ in. The diameter of the air pump is 20 in.; the length of its stroke 3 ft. The delivery valve is situated in the mouth of the air pump; it is of the pot-lid construction, but by a partial application of the principle of equilibrium, the noise and force with which common pot-lid valves shut are greatly abated. A valve so constructed as to be in perfect equilibrium would manifestly not work in an air pump, as no upward pressure would open such a valve; but by the combination of the principle of the equilibrium valve with that of the ordinary pot-lid or spindle valve, a point of adjustment may be arrived at where the valve will open with sufficient facility, without being closed with an injurious force.

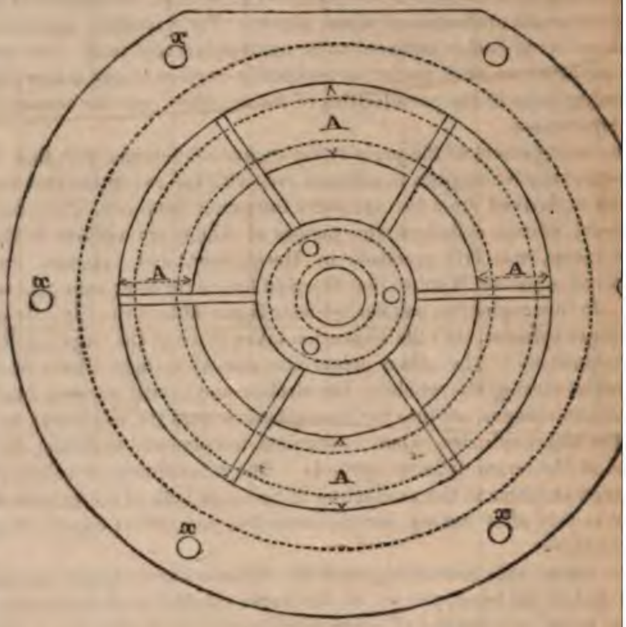
This will be better understood by the annexed section and plan of the delivery valve. For this sketch, as well as for the indicator diagrams which accompany this article, we are indebted to the Messrs. Rennie.

Fig. 1.—Section of Valve.



a a a a a a Fig. 1., is one half of the valve proper, or that part which rises to permit the escape of the air and water lifted from the condenser by the air pump; *b b b b b* is one half of the valve seat, or that part which remains stationary, and against which the valve strikes. The valve seat is bolted by six bolts to the mouth of the pump, by bolts which pass through the holes *x x x x*, Fig. 2. The amount of force with which the valve is closed is that due to the pressure upon the horizontal surface A, Fig. 1, on the ring A A A A, Fig. 2, whilst the real area through which the air and water escape is that represented by B, Fig. 1. Whatever pressure exists upon the side of the valve C, is balanced by the equal and opposite pressure upon the other side C. It is manifest that the more nearly the faces *f* and *f'* are brought into the same vertical line, the less force will the pressure above the valve exercise in shutting it, and the greater will be the force requisite to open it; and if the faces were brought the same line, no force that the greatest pressure beneath the v could produce would ever open the valve.

Fig. 2.—Plan of Valve.



The species of valve applied to the air pump of this engine i tainly superior to that employed in engines in general; but we be that the application of the slide valve to air pumps would be prefe still. One slide valve would perform the united functions of the valve, the bucket valve, and the delivery valve. The air pump p might then be made without any opening through it, the water expelled from the air pump by expression; and if the piston made to travel a short distance beyond the port, no accumulati air could take place in the pump chamber. We cannot enlarge this topic further than to say, that by using a slide valve worke the engine, a better vacuum might be attained in the condenser by any species of valve which is opened by the difference of pre upon its two sides.

A certain quantity of the power which an engine exerts is ex in overcoming its own friction, lifting the water which has ac plished the condensation of the steam out of a vacuum, &c. The horse power is used to denote the available quantity of power w an engine is capable of furnishing for any useful purpose, and is, t fore, the excess of the power produced over the power consum the engine itself. Any estimate of the power of an engine, upon the assumption that the whole power exerted by the pist the true measure of the engine's beneficial exertion, is, there fallacious. An allowance of one-eighth of the power as being sumed by the engine itself, is a usual and moderate allowance.

The amount of economy to be obtained from steam working ex sively is precisely the same, whether the expansion takes place i or in two cylinders. The use of two cylinders serves to equaliz action and to diminish the strain thrown upon the moving parts it is questionable whether the greater fluctuation of pressure only one cylinder is used might not be rendered equally instrum in the production of a regular motion, simply by using a large wheel, or driving the fly-wheel at a greater velocity, and whet is not quite as simple to increase the strength of the moving pa little, as to add an additional cylinder and piston, to prevent them being subjected to so great a strain.

PERFORMANCE OF ENGINE.

The engine makes 19 double strokes per minute.

The consumption of fuel is 132·3 lb. of unscreened Graigola coals per hour.

The area of the smaller cylinder, less ½ the rod, is 186·24 square inches.

The area of the larger cylinder, less ½ the rod, is 749·29 square inches.

The number of feet per minute travelled by the smaller piston is 171.

The number of feet per minute travelled by the larger piston is 228.

The mean pressure in the smaller cylinder urging the piston, as shown by the indicator, is 25·56 lb. upon the square inch.

The mean pressure in the larger cylinder urging the piston, as shown by the indicator, is 6·9 lb. per square inch.

We subjoin indicator diagrams, taken from both cylinders, in the ordinary working condition of the engine.

We are informed by Mr. G. Rennie that the nominal power of the engine is 40 horse power, but that the actual work performed, or power exerted is—

By the smaller cylinder	24·6
By the larger cylinder	35·6
Real number of horses power of engine	60·2

It is right, however, that we should investigate this point for ourselves.

The area of a surface included within the lines of an indicator diagram is a correct representation of the power really exerted by an engine, but the mode of finding a numerical expression for that area by means of ordinates is not perfectly correct; although if there be a sufficient number of ordinates, it may be rendered sufficiently correct for practical purposes. We shall, therefore, take the mean pressure in the smaller cylinder at 25·56 pounds, and the mean pressure in the larger cylinder as 6·9 pounds, as determined by Mr. Rennie.

186·24 × 25·56 × 171 =
814010·3424 ÷ 33000 = 24·6
749·29 × 6·9 × 228 =
1178782·628 ÷ 33000 = 35·7

	60·3
Deduct for friction, pumping water out of condenser, &c., one-eighth	4
Real number of horses power	52·76

Fig. 3.—Indicator diagram of Small Cylinder.

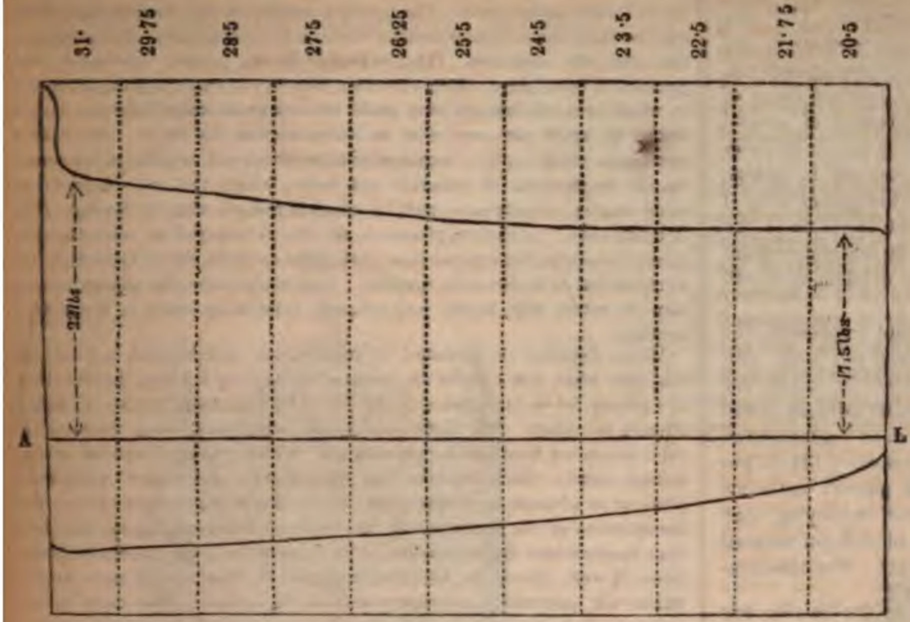
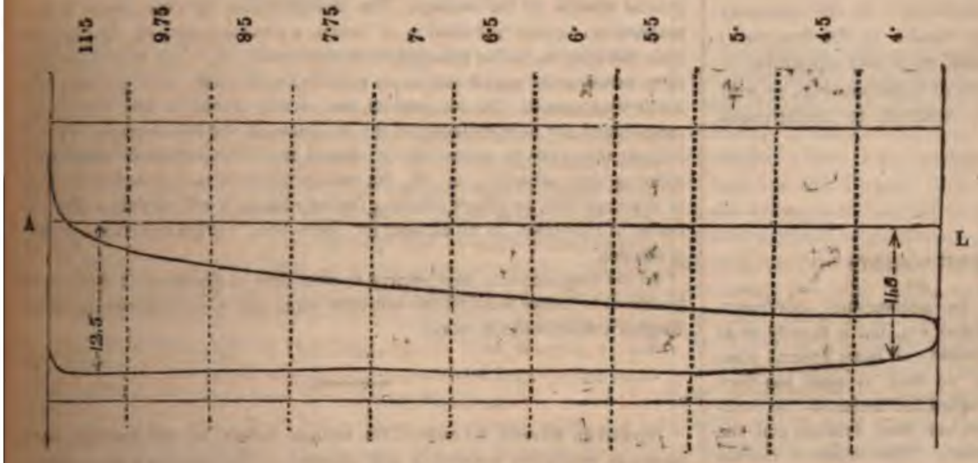


Fig. 4.—Indicator diagram of Large Cylinder.



A L, Atmospheric Line.

It is easy to determine analytically the amount of advantage that is to be derived by using steam expansively. Let the full pressure of steam upon the piston be represented by unity, and let x represent the capacity of the larger cylinder, or the space through which the piston has been moved, whilst urged by the expanding steam. The density will then be $\frac{1}{1+x}$ and assuming that the densities and elasticities are proportionate, $\frac{dx}{1+x}$ will be the differential of the efficiency, and the efficiency itself will be the integral of this, or, in other words, the Napierian logarithm of the denominator. Wherefore the efficiency of the whole stroke, whether the expansion is accomplished in one or in two cylinders, will be $1+$ Nap. log. $1+x$.

Taking the pressure of the atmosphere at 15 lb., and the pressure upon the piston at the commencement of the stroke at 25 lb. above the pressure of the atmosphere, then $15+25=40$ lb. If the steam be cut off at one-fifth of the stroke, or if, as in the present case, the smaller cylinder be one-fifth of the capacity of the larger cylinder, the steam will be expanded into 5 times its original volume. Its pressure, therefore, at the termination of the stroke, will be $\frac{40}{5}=8$ lb., or 7 lb. below the pressure of the atmosphere; but as the average vacuum in the cylinder of an engine rarely much exceeds 24 in. of mercury, or 12 lb. pressure, the unbalanced force of the steam, or the force of steam urging the piston at the end of the stroke will be $12-8=4$ lb. When the steam is cut off at one-fifth $x=4$. The efficiency, therefore, is $1+$ Nap. log. $(1+4)=1+$ Nap. log. 5.

The Napierian logarithm of 5 is 1·6094379, therefore the total efficiency of the steam is 2·6094379, instead of 1. In other words, the efficiency of the steam is rendered one and a half times greater by being so used as to be expanded into 5 times its original volume. This result is perfectly independent of the pressure of the steam employed; but if steam of a considerable pressure be not employed, the cylinders will require to be of inconvenient dimensions. The idea entertained by some persons, that the cause of the economy in the Cornish and other engines which use high pressure steam expansively, lies in the inconsiderable difference in temperature between steam of the pressure of one atmosphere and steam of the pressure of several atmospheres, is perfectly fallacious. Temperature is not in all cases a measure of the comparative quantities of heat resident in bodies. Two cubic feet of steam of the pressure of one atmosphere will, if compressed sufficiently, become about one cubic foot of steam of the pressure of two atmospheres; and whatever may be the temperature of the steam in the two states, the quantity of heat existent in it will be in each case the same.

In common rotative engines, which operate without expansion, the ordinary consumption of coal is 10 lb. per horse power per hour. But the horse power is usually found to be about 52,000 lb. raised one foot high in the minute, which is equivalent to 26·208 millions raised one foot high by a bushel or 84 lb. of coal. Some good engines, however, operate with an effective pressure upon the piston of 13¼ lb. per square inch=60,000 raised one foot high for a horse power; and a few ascend as high as 66,000 per horse power, without employing high pressure steam. The engines consume about 8 lb. of coal per nominal horse power, or 4 lb of coal per horse power of Watt. The consumption of coal in this engine is 132·3 lb. per hour $\frac{132 \cdot 3}{52 \cdot 76} = 2 \cdot 5$ lb. per horse power per hour.

We recommend this engine to the notice of all who are interested in steam machinery. By the use of the Graigola coal, smoke is altogether avoided, and this species of coal is moreover extremely lasting and economical. The engine is elegantly finished; its parts are skilfully and tastefully arranged, and the details of its construction manifest the supervision of the skilful mechanic. In the economy with which it performs its work this engine stands in the first rank; and it certainly works with a smoothness, efficiency, and equability, it would be difficult to surpass. As a specimen of workmanship, as well as an achievement of engineering skill, it is destined to confer much honour upon the Messrs. Rennie.

METROPOLITAN IMPROVEMENT SOCIETY.

WHOEVER has, in any degree, reflected on the architectural movement, which was such a prominent feature in the Georgian era, and is equally so at the present day, must have felt strongly the necessity of some general plan, and of a central controlling body. Whether we look at what has been effected, or what is left undone—whether we regard the useful or the ornamental, the imperfection of the present measures has been evident, and the growing disposition towards remedying this defect. Who thinks of the old city, and looks at the new one which has now risen, without regretting that so many spots where improvement is urgently called for, should have been left untouched? The men of the present day have thrown off the dulness and puerility which infested England in the time of the second and third Georges, and it is plain that we have taken steps to redeem our metropolis from their neglect. Such a period of repose was perhaps wanted after the violence of the civil wars, and the dissoluteness which prevailed under the second Charles. It might be in the social body, as in the human system, that irregular excitement must be succeeded by as great a collapse; and never perhaps was the depth of the bathos so extremely felt in this country as when equally in arms, in literature, and in art, with few, and those not first-rate, exceptions, we had nothing but mediocrity. Nor was the passive endurance of dulness the sole evil there was—a power of warfare active against whatever of beautiful and great our ancestors had left, music was made not only an exile but an alien, painting defunct here was exercised only at the hands of foreigners, and the whitewash brush, which so mercilessly attacked the arts of design in our buildings, was wielded not less energetically in the world of letters. The age of pigtails and milk and water was not contented with self-disfiguration, the same artist who had spoiled his own head, clapped periwigs on the heads of the Romans: and both the country and the theatre witnessed caricatures not only of the proprieties of particular ages, but of human nature itself. The puritans destroyed, the cavaliers disguised, and the Hanoverian dulness finished whatever the presumption of the restoration had left untouched. The dawning of the present movement, the glimpses of better days, which were seen even in the worst, and the processes by which even evil features were made to work good, would take too long a history to sketch now—we must be contented with the result. We have a metropolis which, both in historical remembrances and existing monuments, has all the elements of grandeur and beauty which the most magnificent could desire; our only care must be what to restore, what to destroy, what to build anew. A uniform process is all that is required to unite the dispersed materials; the expense is no part of the question, for in these days the want has but to be felt to be supplied. People are aware that though money may be trifled with, health may not, and expediency sinks in the consideration.

When, therefore, the question of metropolitan improvement has reached that state when men's minds are prepared for its consideration, the formation of a society for its furtherance cannot fail to be a successful means of accomplishing the object. The difficulties which might have arisen from such a plan, emanating from selfish purposes, are well met in the prospectus of the present society, which declares that the society is not formed to originate plans, or to advocate particular views, but to discuss their merits and to draw the attention of the legislature to the subject. Supported as the Metropolitan Improvement Society already is, by many of those who have individually laboured with honour for the same purposes, it must have a moral weight which will powerfully contribute towards its success. The main objects which are to be kept in view are, first, the means of checking the mortality now reigning in over-crowded and ill-drained neighbourhoods; second, affording facilities for commercial intercourse; third, the suggestion of proper sites for churches, schools, and other public institutions, and for parks and public walks; and fourth, decoration or architectural embellishment. The means of consuming smoke is also noticed as a subject for inquiry, and generally all plans and suggestions which have a tendency to forward the general objects of the society. The consideration how the funds for this purpose can be best provided is of course a necessary part of the plan, but little difficulty is to be anticipated on that score, as tax of two-pence or three-pence in the pound will amply provide for all wants, and can meet with but few opponents. To our readers this society cannot be too strongly recommended, for independently of the smallness of the subscription, the self-interest they have in promoting its objects must be a sufficient stimulus for securing their adhesion; as, too, the society proposes to discuss any building or drainage bills, or others affecting the metropolis, it will become a powerful centre of attraction to all earnest for their own welfare and that of their profession.

To the originators of this society a great debt of gratitude is due, for its beneficial influence must be felt not only here, but in every great city in the English empire and the world.

IMPROVED PAPIER MACHE'.—The endless variety of architectural ornaments to which this material is now adopted, is well deserving the notice of the architect and every man of taste. Upon a recent visit to Mr. Bielefeld's manufactory in Wellington Street, Strand, we were much surprised to find the numerous and beautiful forms into which this material is now moulded; foliage, either Gothic, Grecian, Roman, Elizabethan, or Renaissance, is here developed in an endless variety of ornaments for mouldings, cornices, panels, ceilings picture frames, &c., from the most minute mouldings to the largest size, from pateræ of an inch diameter to the centre flower of 66 inches diameter. Capitals of the Ionic order, and Corinthian, from the examples of Jupiter Stator, monument of Lysicrates, the Tivoli and Temple of the Winds, besides numerous capitals of the Gothic, Elizabethan, and other styles. The frames for pictures and chimney glasses are of the most elaborate workmanship; one that we saw in the Show Room, 6 feet by 4 feet, was adorned with foliage of the most beautiful description, with Cupids in alto-relievo, copied from a fine specimen of old oak carving. We might continue on detailing the numerous works collected in this store-house of ornament, and fill our Journal; we therefore must recommend the architect to visit the show-rooms and judge for himself.

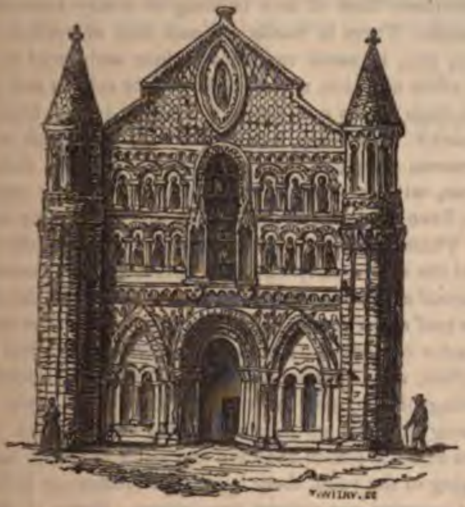
EN AND PENCIL SKETCHES IN POITIERS AND ANGOULÊME: WITH SOME REMARKS ON EARLY ARCHITECTURE.

By George Godwin Jun., F.R.S., &c.

(Continued from page 71.)

Chapter 2.

Fig. 4.

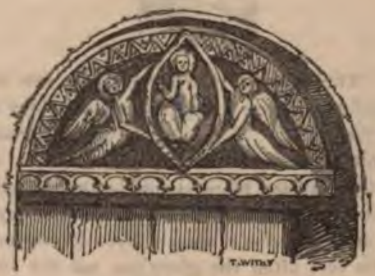


THE western front of Notre Dâme la Grande of Poitiers, represented the above engraving, (Fig. 4,) is a most interesting example of a s of buildings peculiar to this part of France. The possession of e easy to work, the greater influence of Byzantine taste, as well as r circumstances, have produced a marked difference in the architure of various provinces, although proceeding from the same type: while we find in Normandy buildings of simple severity, adorned riorly with little more than zig-zags and rudely-sculptured cor-, we have here façades elaborately sculptured from the ground to summit, presenting not merely highly-enriched and often very ant capitals, borders, and scrolls, but multitudinous figures in all ginable positions, and in very high relief. The absence of the tern towers, too, in the structures we are now speaking of, constitutes her marked difference from the Norman buildings.

he date of the erection of Notre Dâme is probably at the end of 11th or beginning of the 12th century; but the entrance front is uestionably more recent. This part of the building, which is ded by clusters of columns supporting two small circular turrets conical stone roofs, is divided into three distinct stages by ened cornices, and terminates in a broken pediment or gable, (so to k,) which is also divided horizontally into two compartments. entrance doorway, which is recessed, is semicircular in the upper , as are the arcades above containing figures; but the blank openon either side of it has a pointed head with two small semicircular es beneath it. The spandrils beneath the first cornice and corbels ain a series of bas reliefs, representing on the left-hand side of spectator Adam and Eve, Nebuchadnezzar, some of the prophets, an angel announcing to Mary the dignity of her coming child; and he other side the meeting of the Virgin and Elizabeth, and the of the Saviour. Over the doorway is a circular-headed window, a canopied niche on either side, which is an interpolation of later s. The figures in the arcades represent the apostles and two ops. The lower part of the gable is inlaid with a series of small ular discs, and the upper part of it with squares placed diagonally: in the centre of the two parts is sculptured a large *vescica piscis*, containing a figure of Christ and symbols of the four evangelists, namely the bull, the angel, the eagle and the lion.

The veneration in which the form called *vescica piscis* appears to have been held, and its constant occurrence in ancient buildings, have afforded matter for much disquisition. The early Christians symbolized our Saviour by the form of a fish, because, as has been supposed, the initial letters of Christ's name and titles form the Greek ΙΧΘΥΣ (fish): moreover, according to Tertullian, who wrote in the second century, they called themselves *Pisciculi*, considering that the Christian life commenced in the waters of baptism.* The fish itself was accordingly sculptured for decoration, but seems to have been afterwards superseded by the fish-shaped compartment formed by the intersection of two equal circles, in some cases rounded at one end. In England this is found in a variety of positions and of various dimensions, both in stone and on painted glass: it is to be seen over many doorways, enclosing the figure of Christ,—as for example, in the south porch at Malmsbury Abbey Church, (represented in the annexed sketch, Fig. 5,) at Barfreston, and at Rochester Cathedral. Medallions of this shape, containing sculptured figures, occur frequently round the doorways of Anglo-Norman buildings, as at Malmsbury; and windows of this outline are found at Romsey Church, Hampshire, Beverley Minster, Yorkshire, Salisbury Cathedral, and elsewhere. In York Cathedral a boss in the groining presents the *vescica piscis* enclosing a figure of the Virgin. The rose window at the south end of the south transept of Lincoln Cathedral is formed by the tracery into a *double vescica;* while (stepping from England into Germany,) over the west door of the Church of St. Cunibert, Cologne, a ***half vescica*** occurs, enclosing the lamb. The seals of most religious bodies, as well as of individuals, were of this shape, and continue in many cases to be so; it was likewise delineated constantly on ancient tiles, as may be seen in many of our old churches: some antiquaries have even attributed the whole origin of the pointed style of architecture to the use of this form. Some writers have applied the term *vescica piscis* to two circles intersecting each other in the centre, and not to the form produced at their intersection, and have asserted the influence of this symbol over the plans of early edifices. In many instances, certainly, the prevalence of

Fig. 5.



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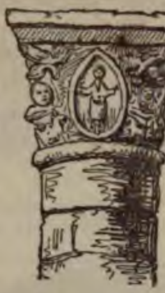
* "Nos pisciculi secundum Ιχθυν nostrum Jesum Christum, in aquâ nascimur." *Tertul. de Bapt., cap.* 1. Optatus, who wrote in the fourth century, throws some light on this passage thus:—"Cujus piscis nomen secundum appellationem Græcam in uno nomine per singulas literas turbam sanctorum nominum continet Ιχθυς, quod est Latinum Jesus Christus, Dei Filius, Salvator." He refers also in a mystical manner to the fish recorded in the book of Tobit. An annotator upon Optatus refers to Clemens Alexandrinus for confirmation of his use of Ιχθυς; but on examination of the context, it does not seem that Clemens at all intended to allude to it. A reference however, to St. Augustine is more satisfactory. In his work *De Civitate Dei, lib* 18, *cap.* 23, he writes, "Horum autem Græcorum quinque verborum, quæ sunt Ἰησους Χριστος, Θεου υιος, Σωτηε, quod est Latinè, Jesus Christus, Dei Filius, Salvator, si primas literas jungas erit Ιχθυς, id est, piscis, in quo nomine mysticè intelligitur Christus, eo quod in hujus mortalitatis abysso, velut in aquarum profunditate vivus, hoc est, sine peccato esse potuerit." The origin of this species of acrostic, according to him, is in the Sibylline verses, some of which seem really to have been prophetic of our Saviour (being probably grounded upon the Jewish prophecies, which had gradually after the Captivity found their way among the heathens), while some were clearly interpolated by the early Christians, who seem, even in those days to have given way occasionally to the temptation presented by a pious fraud.

this form is strikingly apparent; but whether this may not result from the dependence of the early architects on geometrical proportion and fixed principles, (equally in the middle ages as in classic times,) I will not inquire. The symbolism of ancient architecture is an enticing but a dangerous subject to enter upon.[*]

In the towns under notice, the *vescica piscis* occurs prominently in the gables of the churches, as it does also at times in the painted adornments.[†] In one instance, I found it sculptured on the capital of a column, namely, at the entrance doorway in the tower of St. Porchaire, Poitiers; and of this, the annexed sketch, Fig. 6, gives a slight representation.[‡] The French writers, with some few exceptions, do not recognise this form in their descriptions as anything more than "a sort of oval," or "a glory." M. Didron, in an erudite and interesting paper on the nimbus, printed in the "*Revue Générale de l'Architecture*,"[§] says the term *vescica piscis* should be repudiated by all for its grossness. M. Didron continues, "it was invented by the English antiquaries, who use and abuse it abundantly. Moreover this denomination is false, for very often the glory has not the form which the term suggests. This glory has been also called the sacred oval, and the mystic almond; but the word mystic suggests a symbolic intention which may very reasonably be doubted: besides, frequently it is neither of an oval nor an almond shape; it is simply the glory of the whole body, as the nimbus is the glory of the head.[||] The head is round, the nimbus is round; the upright body forms a lengthened oval, and the glory generally assumes a similar form. But when the body is seated, the oval is contracted to a circle. Sometimes it becomes a quatre-foil, so that the four prominent portions of the body, the head, the legs, and the two arms, have each their particular lobe or section of the nimbus."

Fig. 6.



With the greatest respect for the opinion of M. Didron, I am unable at once to assent to this apparently clear and straightforward explanation. The constant recurrence of this particular form, any departure from it being apparently but the exception from a rule; the fact that in very many cases the *vescica piscis* encloses a *sitting* figure, and in others no figure at all; that the quatre-foils spoken of may actually be formed by one *vescica* crossing another; and its use for episcopal seals and for windows, as before alluded to, are all points that might be urged in objection. Touching the *invention* of the term *vescica piscis*, Mr. Kerrich states that it is spoken of by Albert Dürer, in a work published in Paris at the commencement of the 16th century, as one perfectly well understood at that time.[*]

To return, however, from this digression, to Notre Dâme of Poitiers. What has been said, aided by the engraving, will be sufficient to show that the entrance front of this building is a very extraordinary and striking work. There is hardly a square foot of surface that is not elaborately, and, in some cases, beautifully sculptured in very bold relief, the effect of which, when heightened by colours and gilding, (as it appears from traces was formerly the case,) must have been very extraordinary.[†] The south side of the building, which is partly exposed, presents simply a range of blank openings, formerly windows: these, with the exception of two immediately adjoining the west front, have semicircular heads; the two exceptions are slightly pointed. There is a central tower in three stories, (the two lower square, and the upper story circular,) covered with a conical roof, the stones whereof are formed into scales, as likewise are the stones composing the roof of the turrets in the entrance front before mentioned.

The interior consists of a nave and side aisles, (the latter being very narrow), choir, with semicircular termination, and attached chapels. The vaulting of the nave is wagon-headed, with plain horizontal bands passing from column to column; that of the aisles is groined. The arches which separate the nave and aisles are lofty, and go up to the springing of the vault, there being no clerestory or triforium: the whole is of massive yet elegant proportions. Some of the capitals, although for the most part plain, are sculptured with interlaced ornaments.[‡]

At the south-western extremity of the town is a church dedicated to St. Hilarius, one of the most eminent of the bishops of Poitiers, who lived in the fourth century, and was distinguished by his active opposition to the Arians.[§] Clovis in the sixth century rebuilt a ruined chapel which had been erected over his tomb: this, in its turn, was destroyed by the Normans about the year 863, and the present church was built at the commencement of the 11th century, and consecrated in 1049. Originally it was much larger than it is now, and was divided by six ranges of columns into a nave, with three aisles on each side, covered by six cupolas. During the revolution the building fell greatly into decay; so much so, that when its repair was desired, a commission appointed for that purpose foolishly determined on destroying a great part of the original structure, instead of restoring it.

The building as now seen is accordingly much confused in arrangement, but presents, nevertheless, a striking interior. It is semicircular throughout, with a plain wagon-headed roof in part, the arches supporting which go up to the springing of it, without the interposition of triforium or clerestory. At the back of the high altar is a semicircular range of columns, with plain cushion-capitals, of lofty and elegant proportions. Some of the other columns in the church have capitals sculptured into representations of men and animals. The head of one arched opening outside the tower is cut on the face and the intrados, in imitation of an arch formed of three layers of billets of wood, a caprice on the part of the architect or the masons not common.

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[*] As an early example, though, of the practice of symbolic architecture, if it may be so termed, a passage in the 18th chapter of the 1st book of Kings occurs to me:—"And Elijah took twelve stones, according to the number of the tribes of the sons of Jacob, and with the stones he built an altar in the name of the Lord." This was about a thousand years before our era.

[†] Dallaway says of the *vescica piscis*, "In the earliest era of the masonic establishment, a geometrical figure or canon was adopted in all sacred buildings, which had an import hid from the vulgar. As it had a decided reference to the Christian religion, it might have been invented by the Church; but it has likewise an equal analogy with other mysteries professed by the first societies "of masons." * * It may be traced from the church of St. John Lateran and old St. Peter's at Rome, to the church of Bath, one of the latest Gothic buildings of any consequence in England."

[‡] The tower of the church of St. Porchaire, apparently of the end of the 11th century, is in character what we should term Norman. A very wide doorway occupies nearly the whole width of the tower between the buttresses. Above are three stories separated by ranges of sculptured corbels (mostly heads), and containing arched openings and columns. The recesses being deeply sunk, the columns large, and parts bold, the effect of this tower is very picturesque and striking.

[§] A French periodical, conducted very ably by M. Cæsar Daly, which deserves to be better known in England than it is.

[||] Mr. Hope thinks differently, even of the nimbus. He says, "The Pagan fashion of protecting the heads of deities, often, even in temples, exposed to the outer air, from the insults of birds, each by a metal discus, had by degrees so associated with that head-piece an idea of dignity, that the Christians adopted the form, in order to mark, even in painting, the character of saintship: thence the nimbus introduced over saints in the more ancient paintings and mosaics, so far from being intended to represent a mere aureole, or glory of intangible rays, emanating from the wearer himself, is only the representation of a solid platter of silver or gold, often adorned with scrolls foliage, gems, &c. fitting the skull."—*Hist. of Archit. p.* 173.

[*] Archæologia, Vol. XVI, p. 313.

[†] The whole width of this front is 57 feet. It may be mentioned, that the mortar joints are not large, but that the stones, where not decayed, fit closely together.

[‡] The height of the vaulting in the nave is about 54 feet, that of the aisles about 36 feet. The whole length of the building inside is stated to be about 187 feet, and its width 44 feet.

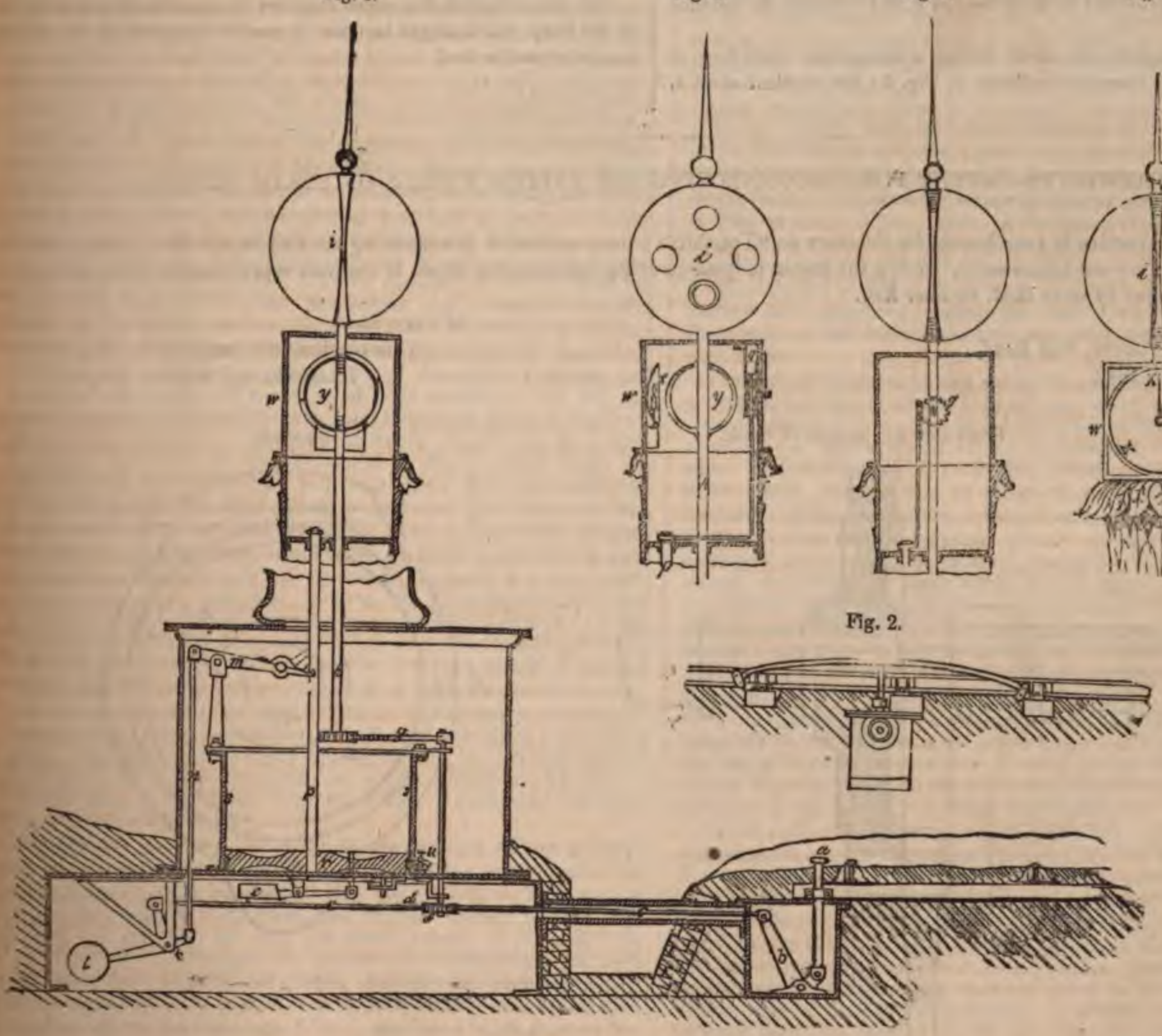
[§] He was the author of the *Te Deum* still used.

Among the eminent individuals of whom Poitiers was in old time the residence, the memory of none is more respected than that of Ste. Radégonde, wife of Clotaire I, who, abandoning the pleasures of the world and her high position, established herself in Poitiers, and founded there, about the middle of the sixth century, an abbey, which took the name of *St. Croix*, from a relic of the true cross given to Radégonde by the emperor Justinian. Near the monastery, but beyond the walls of the city, she built a church for the burial of the sisterhood. This is supposed to have been destroyed by the Normans in 1084, and rebuilt at the expiration of the same century.

The church, as it now remains, is noticeable for the large span of the vaulting over the nave, which has no aisles. The structure is chiefly of semicircular work, and has a lofty arcade against the side walls of the nave, similar to that already mentioned in the cathedral. The choir has an aisle on either side of it, with a semicircular absis and two small chapels. Beneath the high altar is a chapel, containing the remains of Radégonde, in a black marble tomb of evident antiquity. Externally the church has a square tower at the western end, the upper story of which is octagon. Against the north side of the tower is a circular turret with a conical roof, which renders the general effect of the tower picturesque. The walls of this building, both inside and out, are literally covered with masons' marks, in some cases precisely similar to those about the cathedral.

The only other church in Poitiers is that of Montierneuf, which was commenced in 1076, by Guillaume Guy Geoffroy, Count of Poitiers, but was not completed till twenty years afterwards: the choir was afterwards rebuilt. An attempt has been made to render the whole of the interior classical, by sculpturing an egg and tongue around the capitals of the columns, and other unwise contrivances. On the roof outside are two turrets, with conical roofs and arched openings, similar to those at Notre Dâme la Grande, but smaller and more rude.

ROBERT B. DOCKRAY'S SELF-ACTING RAILWAY SIGNAL.



The intention of this signal is to notify to an approaching engine-driver, that a preceding train has passed any given point upon a railway at a certain interval of time before him. It is proposed to fix it at the entrances to tunnels, in deep cuttings, where the curvature of the road obstructs the sight, or in any other position where it may be thought desirable to warn the engine-drivers, without the expence of having policemen in constant attendance to give the necessary signals.

Description of the Drawings.

Fig. 1, is a section through the signal, and one line of railway.

Fig. 2, is a section and elevation taken through the connecting rod, and parallel with the line.

Fig. 3, is an elevation of the disc and lamp head, showing the face of the clock, figured 5, 10, and 15 minutes.

Figs. 4 and 5 are sections of the lamp head.

[illegible] section [illegible] over which [illegible] and it so [illegible] is attached to the [illegible] the [illegible] the end [illegible] balance weight l, the [illegible] by means of the con- [illegible] the upper [illegible] shown to a larger [illegible] having a rack work- [illegible] which the fingers [illegible] at the top, and has a [illegible] during its ascent, [illegible] the air from under the [illegible] the air out before it, [illegible] the aperture, and thus by [illegible] for the revolution of the [illegible] diminished at pleasure; the [illegible] of the cylinder, lifts the catch e [illegible] in the rod c, and releases the balance [illegible]

[illegible] the clock, having a transparent white face, is [illegible] and reflector x, Fig. 5; the vertical shaft h, which carries the day signal i, also carries a disc of red glass, y, fixed within the lamp, and between the clock face and the light, and also in the same vertical plane as the day disc; consequently, when the quarter turn is given to the shaft h, the red glass is turned before the light, and the clock face is illuminated red, and thus calls the attention of the engine driver to the clock face.

Mode of Action.—The inclined plane a, in descending, draws the rod c forward, and lifts the weight l; the catch e descends into its notch, and retains them in this position; in the mean time the red disc i has been turned by the rack d so as to be visible from the line, the piston r has been lifted to the top of the cylinder, and descending by its weight, communicates motion to the clock; on reaching the bottom of the cylinder, it lifts up the catch e, which, rising out of the notch in the rod c, releases the balance weight l, which, by its gravity, brings the different parts of the apparatus into their first position, and the signal is ready for the passage of another train.

By these means the engine-driver, on passing the signal, and looking at the clock, can tell by night or by day how many minutes have elapsed since the passing of the previous train, and either stop until the time for the revolution of the hand has expired, or regulate his speed, according to his instructions.

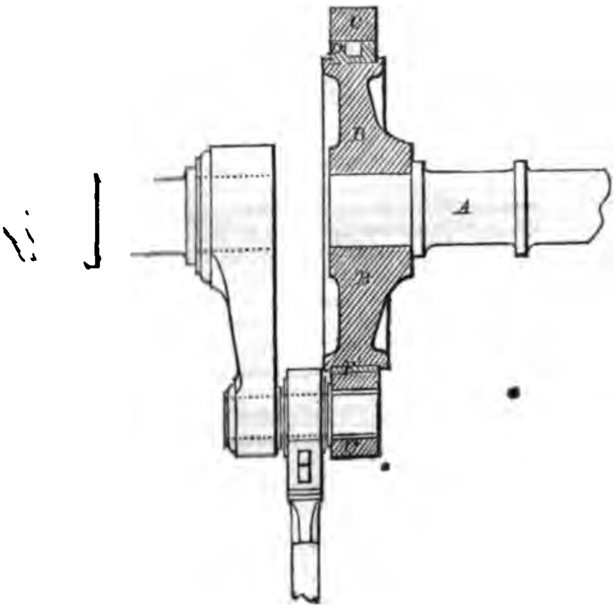
The only attention the signal requires is the cleaning and lighting of the lamp, which might be done by one of the plate-layers, who are always upon the road.

TREWHITT'S PATENT FOR DISCONNECTING THE PADDLE-WHEELS OF STEAM VESSELS.

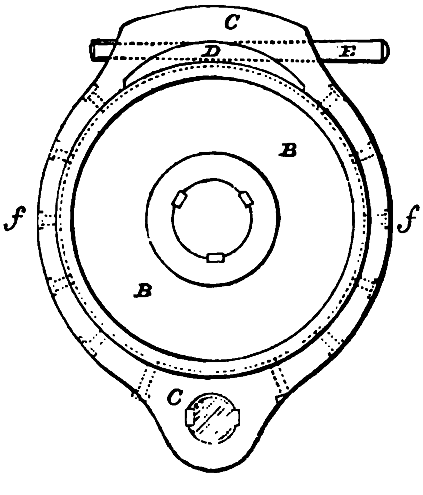
[illegible] observing a notice in your Journal for February on "Trewhitt's patent method of disconnecting the Paddle-wheels of Steam Vessels," [illegible] there are several inaccuracies, we beg the favour of your inserting the enclosed, which is a correct representation and description of the apparatus applied by us to H.M. steamer *Kite*.

We are, Sir,
Your obedient Servants,
Braithwaite, Milner & Co.

[illegible], *New Road*,
[illegible] 11, 1842.



Front view and section of crank.



Side view.

Explanation of the Drawing.

A. The Paddle Shaft. B. A cast iron Disc keyed thereon. C. A wrought iron Strap surrounding the Disc, lined with brass. D. A brass Cushion. E. A tightening key for producing friction, by bringing the Cushion in contact with the Disc. F. The brass lining the wrought iron Strap excepting that portion occupied by the Cushion. *fff.* Screws by which the brass lining is held to the Strap.

A few blows of a hammer on the key E will connect or disconnect the Paddle-shaft, even when the engines are at full speed.

REVIEWS.

The Present State of Ecclesiastical Architecture in England. Dublin Review: No. XXIII.

The satisfaction we feel at meeting with an architectural paper of such very unusual extent—for its length exceeds a hundred pages, with numerous foot notes in small type, and illustrated, besides, with 17 plates—our satisfaction, we say, is greatly abated, at finding so very large a portion of it devoted to non-architectural matters, and, in fact, the subject itself made a stalking-horse to ecclesiastical controversy—to lamentations for "the desecrated state of England's churches after the great schism of the sixteenth century," intermixed with such occasional specimens of holy hatred and pious execration as that where the writer denounces "the *blasting influence* of Protestantism and Paganism combined!" From this last somewhat startling expression the tone and spirit of the article may easily be inferred; and though there is occasionally a show of candour, in complimenting those who have evinced a desire to restore, to a certain extent, some of the forms that have fallen into disuse, into our church-service, we cannot help looking upon it as no better than cajolery. The interest pretended to be felt can hardly be sincere, otherwise than as it proceeds perhaps from the latent hope that the return to some ancient usages will proceed, step by step, till all shall have been restored; and, with those external customs and usages, creeds and points of doctrine likewise. Sincere, however, or not, it certainly does appear to us, that the concern here expressed in regard to our protestant churches and their architecture, is somewhat inconsistent—not to call it officious—somewhat too much akin to the concern we may suppose the Bishop of London to give himself in regard to the synagogues and Quakers' meeting-houses, and the forms and regulations adopted in the various sectarian places of worship in his diocese. But we are now falling into the error we have just animadverted upon as pervading the article in the Dublin Review, and therefore quit such remarks as those just made, for others of more immediate interest to our readers.

We are so very far from being opposed to reform in our present system of church architecture, that we consider it loudly called for, since, with comparatively few exceptions, the numerous churches erected in this country of late years are the very reverse of satisfactory, being stamped not only by the meanness occasioned by injudicious parsimony and mistaken economy, but by downright vulgarity and pertness of character. We are aware that architects will say the fault does not at all rest with them, since they do as much as the funds afforded them will allow. We must, however, plainly tell them that, as often as not, they do not accomplish *so much* as they might do, merely because they aim at *so very much more* than can possibly be accomplished under the respective circumstances. If a design answers, as far as name goes, to some particular style, by the forms adopted for windows, and a few other features of that kind, no attention is paid to the genius of the style itself, or to such treatment of it as is requisite to keep up its proper character. Seldom, too, is any regard paid to the exigencies of the particular case, for many new churches look as if the designs for them had been merely copied, with some trivial alteration, from those pattern-books of them published for the benefit of country architects, and brought down to the taste of parish committees. Or, does a design happen to be objected to, as too expensive, or as otherwise requiring some curtailment, a very easy remedy is resorted to, namely, that of paring it down, or lopping off from it, by which process it must of course become *simplified;* and a most simple-looking affair it generally turns out, looking very much like a cock that has been stripped of all its feathers.

Now the fact is, nearly all our old village churches rise up in judgment against modern church architects—at least the majority of them. Such structures may be homely, but they are not vulgar; they may be uncouth, they may be even mean, may be rude enough both in construction and material, but they are never vulgar, except, indeed, where they have undergone the process of "beautifying" to such extent, that their original and proper character has been destroyed. It is unquestionably true that, for the impression they make both upon the eye and the mind, buildings of the class alluded to are more or less indebted to the effects of time. Equally true is it, that it is beyond the power of the architect to create antiquity, and confer on his buildings, in addition to the venerable appearance, the accumulated associations derived from it. Still, apart from that element of their character, there are others which recommend the class of churches alluded to, if not exactly as models, as *studies*, at the present day, which, if properly turned to account would go far towards correcting that insipid triviality, and that vulgarity, which, together with a certain uncomfortable look of starvation and flauntingness combined, are the besetting sins of most of our modern *soi-disant* Gothic churches, and not least of all those which, because they are stuck full of naked lancet-holes, assume to themselves the title of the early English style, whereas they have in fact nothing whatever of the character of that style; nothing of the feeling belonging to it, nor aught of that which gives it value. One exceedingly great fault in the church architecture of the present day arises from the meagreness and formality produced by a number of uniform apertures, stuck so closely together as not only to destroy all repose, but produce a very disagreeable appearance of want of substance and solidity. It is true, in the later perpendicular style the proportion of the apertures to the solids is very much greater—so much so, that many structures in it may be compared to lanterns, being in fact nearly all window; but then the character is of a very peculiar kind, the whole forming a consistent design of elaborate screen-work, as it were, which would almost admit of being perforated throughout. Instead of being mere gaps, the windows themselves are filled with screen-work, with numerous mullions, transoms, and tracery, so as to combine the appearance of strength with that of richness. Where, on the contrary, the windows are so far from contributing at all to decoration that they are little more than so many blank surfaces of glass, with scarcely any external moulding or finish to the apertures—as is the case with not a few of our modern-antiques, or pseudo-early-English—they ought to be as few, in other words as wide apart, as possible.

If very few architects seem to understand simplicity, there are as few who seem to be able to appreciate the value of sobriety in design; or we might suppose that sobriety is so exceedingly expensive a quality that they cannot afford to make use of it, except on very rare occasions. Be that as it may, it is certain that much of what is more or less unsatisfactory, if not decidedly reprehensible, in our recent church architecture, arises from a want of attention to sobriety in composition. Hence moderate-sized churches are made to look like miniature editions of large ones; owing to which preposterous ambition, instead of gaining in importance, they become more insignificant in appearance than smaller ones with the proper character belonging to them as such. While it does not absolutely exclude a higher degree of decoration than usual, sobriety requires that the decoration itself should be applied somewhat sparingly; that the features of the composition should be few, but carefully studied, and individually satisfactory and capable of bearing the test of examination. Richness there may be, but sobriety and trumpery are totally irreconcilable with each other.

For calling attention to this point we may very well be excused, since it is one that is oftener than not completely overlooked; though were it attended to, we should behold fewer of the miserable minikin abortions and spawnings of church architecture that now meet our eyes. Intimately connected with the disregard of sobriety, there is another very prevalent fault in designs of the class alluded to, namely, excessive meagreness and monotony of composition, quite the reverse of what is observable in buildings that are or ought to be looked to as examples, or at least, as studies. Assuredly it is not a little inconsistent, that while so much stress is laid upon style, and so much importance attached to precedent, the character of the one and the authority of the other should be utterly disregarded—if not universally, far too frequently—in general design or composition. Our modern Gothic churches have for the most part an exceedingly offensive box-like appearance, without anything to break the outline, either horizontally or on the plan; without anything to take off from the flatness and insipidity of the elevations, to produce effect of light and shade, and contrast of lines in perspective. Consequently, unless the design be of very superior quality as to beauty of detail and execution, the whole structure is apt to look deplorably naked and bald.

As we write not to compliment or flatter, but if possible, to instruct and improve, we must speak out plainly, and tell the profession that, if we may judge from their essays in it, they have yet very much to learn in regard to the proper *treatment* of Gothic architecture, and, we might perhaps add, of Grecian also. It may be that they are frequently thwarted by the obstinacy and ignorance of other persons—by that collective stupidity which calls itself a committee, and which insists upon a design being accommodated to its own notions and whims. On which side the fault rests, or whether it is to be shared between both, we pretend not to say; but we will say that if the character of Gothic architecture, or of any of the styles belonging to it, cannot be better kept up than it usually is when such style is applied to modern churches, it becomes a question whether it would not be better to repudiate it altogether, or at any rate to employ it only where circumstances allow of its being properly kept up in every respect.

For the interiors of churches as at present required to be laid out, the greatest possible extent of accommodation as to sitting room being made the *sine quâ non* to which all other considerations must yield, the Gothic is not particularly well calculated, because it must be violated more or less, except when galleries can be dispensed with altogether, and open seats and stalls be substituted for pews. We do not blame architects for not accomplishing impossibilities; for if similarly blocked up and built up, the beauty of the finest Gothic interior would inevitably be greatly impaired, if not destroyed: but we regret that such style should be so applied, or rather misapplied, since even a tolerable semblance of it can hardly be kept up. For this last reason, perhaps, it is that generally no attempt whatever is made to keep it up at all; and we have seen churches in that style which, though tolerable enough on the outside, have been most intolerably bad within—without the slightest pretensions to style, without any sort of architectural beauty, and without any solemnity of character, unless dismalness and pauper-like meanness can be considered equivalent to solemnity. If, in addition to the rest, aisles also are to be blocked up by pews, they had better be omitted, since they certainly contribute nothing to architectural effect, and as little to commodiousness, those there seated not being in the very best situation for hearing distinctly.

It seems to us, that by employing the Gothic style—at least, as it is now employed—we inevitably force comparisons not very flattering to Protestantism in its relationship to art. It admits of no dispute that Catholicism is infinitely more favourable to architecture and the other arts. Its very character—its taste for religious parade, and pantomime, and pageantry, and processions, and for all the paraphernalia and pomp of devotion, render it pre-eminently picturesque and scenic—the religion for the artist, *quoad* artist; which unconditional admission on our part must satisfy both the Dublin Review and Mr. Pugin; for were we to express our sentiments of Catholicism as a religious system, and to be as free in our remarks as the writer in the Review is upon Protestantism, we should not satisfy them at all.

In regard to the symbolical character of church architecture, to which so much importance is attached by the Reviewer, we shall merely observe that it appears to us very fanciful—historically interesting, perhaps, as showing the religious spirit of former ages, but not at all likely to be revived now, it being, in fact, totally disregarded in Catholic countries. Indeed, though they do not care even to hint as much, many recent specimens of ecclesiastical architecture, both in France and Italy, must scandalize Messrs. Pugin & Co. not a little. Not to mention others, La Madeleine at Paris, and Canova's church at Possagno, must appear to them awfully heterodox—manifestations of the "blasting influence of Paganism," *without* Protestantism. The Reviewer, however, does speak of "the Pagan courts of the Medici;" and while he was casting reflections upon the questionable taste which attaches such high value to the Elgin marbles, he might have added a few upon that which has converted the sovereign abode of St. Peter's successor into a Pantheon of Pagan divinities, and a storehouse of heathen mythology: but those scandals were of course in the wallet *behind* his back.

Dismissing the rest of the article without further comment—for if not so already, the Review itself will doubtless be in the hands of most of our readers, ere long—we now turn to the plates, which, with one exception, are representations of buildings erected by Mr. Pugin. And hardly can he be accused of having flattered them, or attempting to do so, since they are drawn and etched in a most affectedly rude manner; and some of the subjects are rendered still more uncouth by being shown in bird's-eye perspective—a most unnatural and unpictorial mode of representation. It is, perhaps, chiefly owing to these circumstances combined, that the illustrations are so little prepossessing, except to those who may admire them because they studiously imitate all the defects of old engravings at a time when architectural delineation was in its infancy. Spirit and freedom are very desirable, but accuracy of form is an indispensable requisite in drawings whose value depends upon their truth as graphic descriptions, and that such accuracy is not incompatible with artist-like feeling the publications of the elder Pugin sufficiently convince us; in this respect, therefore, the son appears to have degenerated from the sire. Granting, however, that as etchings they may be called spirited, some of the designs themselves appear to us not a little insipid, and to be very deficient in that spirit which the style derives from well expressed detail. Such character there may be in the buildings themselves, yet so far from being shown, it is not even indicated here. On the contrary, in some of the subjects, for instance St. John's Hospital, Alton, and the bishop's residence, Birmingham, it appears to be wanting altogether; there being a good deal in them that looks scarcely of better quality than those spurious "Gothicisings" which Mr. Pugin himself has so loudly reprobated. This is particularly the case with regard to the bishop's house, which, besides being remarkably *queer* and uncouth, has the appearance of being an old structure altered and patched up and huddled up, from time to time, without the slightest attention to consistency of design. So far, indeed, it may pass for being picturesque; yet Mr. Pugin must surely be aware that though such kind of picturesqueness is agreeable enough in itself, where it has really been the growth of time and successive changes, and where beauty is out of the question, it becomes little better than an offensive piece of affectation when perpetrated for the nonce, and to the extent in which he has indulged in it. Difficult as it may be to effect, in design we look for picturesque quality combined with architectural unity of expression, if not always with perfect regularity. In his horror of the frigid formality and smirking pertness of the carpenters' Gothic school of design, Mr. Pugin has run quite into the contrary extreme; while the former, therefore, are clearly in the wrong, he himself is far from being yet quite in the right. He is too apt to give us architectural farragos, instead of designs: he succeeds in individual features and parts, but he is by no means happy in composition. His reverence for precedent causes the antiquary to prevail in him over the artist to such a degree, that he may be compared to the precedent-loving Chinese tailor, who, being employed to make a new coat, copied every patch upon the old one sent him as a pattern.

Memoir on the Practicability of shortening the duration of Voyages by the adaptation of Auxiliary Steam Power to Sailing Vessels. By SAMUEL SEAWARD, F.R.S., M. Inst. C.E. *From the Transactions of the Institution of Civil Engineers. Part V, Vol.* 3, 1841.

THE fearful expense which has been found to attend the extension of steam navigation to voyages of extraordinary length appears to constitute an insuperable obstacle in the present state of the steam engine to the beneficial establishment of lines of uninterrupted steam intercourse between distant continents. The imperfect success which has attended the development of the several enterprises which had for their object the maintenance of a steam communication between Great Britain and New York, is a proof of the difficulties which wait upon the performance of long steam voyages, and furnishes a lesson which will not be readily forgotten by future speculators. The successive disappearance of the Sirius, Royal William, Liverpool, United States, British Queen, &c., from the Atlantic station, proclaims with a voice as authoritative as that of a messenger from heaven, that the Atlantic enterprise has been a failure, and that a perseverance in its prosecution, *under the same circumstances* which drove those vessels from the field, can only add energy to ruin and flagrancy to guilt.

For several years past the project has been in contemplation to adapt steam power to sailing vessels, in such a manner that it may be used or discontinued at pleasure, and it is the object of the author of the work before us, to recommend the extended adoption of steam power in sailing ships, as being productive of the most prominent of the benefits which steam navigation confers, without entailing any serious expense for the maintenance of its operation. A good ship, when impelled by a favourable wind, will realize a velocity which few steam vessels are able to surpass, and it is only in calms, or when the wind is adverse, that the peculiar powers of a steam vessel are productive of benefit. It becomes a question, then, whether it would not be advantageous to so adapt steam power to sailing ships as to be only used in calms, or in adverse circumstances of wind and water.

In order to form any comparative estimate of the benefits of this proposed application of steam power, it is necessary to refer to the circumstances which attend the voyages of sailing ships and of regular steamers upon the open sea. In some of the lines of intercommunication between distant countries, vessels are exposed to strong periodical winds or protracted calms, whilst other lines are distinguished by winds which sweep across the ocean in one direction for nearly the whole year. In calms such as those that prevail about the line, and by which vessels on the route to India are often for a long period detained, a small proportion of steam power might be most beneficially employed in transporting the vessel from the region swept by the current of wind which flows from the pole towards the equator, into the locality of those land and sea breezes which enable the vessel to continue her voyage; but the same proportion of steam power would be perfectly unserviceable in propelling a properly rigged ship against a strong adverse wind. For such a service a proportion of power to tonnage similar to that observed in our fastest steamers is indispensable, and it is only therefore in voyages where calms are likely to be met with that the adaptation of auxiliary steam power to sailing ships can be productive of benefit. Upon the superior economy of vessels supplied with auxiliary steam power, Mr. Seaward makes several very sensible observations:—

"A most material circumstance affecting the utility and economy of steam vessels of great power, is the space necessarily occupied by the engines and the supply of coals, which are found to require three-fourths of the whole area below deck, leaving only one quarter for the stowage of cargo; and that, owing to the great weight of the former, must principally consist of measurement goods. Thus the "President" and the "British Queen," although of 2000 tons register, have never been able to carry more than 500 tons of measurement goods as freight.

"From a due consideration of these features of the question, with respect to the expediency of employing large steam vessels (and it is believed that few practical men will dispute the facts by which they are developed), it is evident that the attempt to perform voyages of lengthened duration by the power of steam alone must, in the present state of engineering science, be attended with an expense wholly disproportionate to the profits."

"The present state, therefore, of steam navigation is evidently altogether inadequate to meet the large and daily increasing demands of commerce; and in this respect, as far as maritime navigation (as contra-distinguished from river and coast navigation,) is concerned, steam must be considered to be in its infancy, for the communication by this means with our own or with foreign distant colonies—India, *viâ* the Cape of Good Hope—the West Indies—the Pacific Ocean—Australia—the Brazils, and other highly productive countries, is at present impracticable to any extent, as the facts hereafter stated will more distinctly show."

"Before entering upon the details of this scheme, either as regards its past success in the partial and limited application which it has hitherto received, or as to its future adaptation, it may be desirable to describe the class of sailing vessels to which auxiliary steam may be regarded as an applicable power, and where its employment may be expected to be attended with success; and here it must be observed, that commercial and not scientific success is the result looked to, for nothing can be considered successful in a commercial point of view, to which a fair profit upon the capital employed does not attach."

The definition of the term "success" here given might be looked upon as unnecessary, had we not before us the remembrance of the strange perversion of the plainest language, during the discussion of the Atlantic steam enterprise. In that case success was regarded as synonymous with practicability.

Mr. Seaward informs us that auxiliary steam power is beneficially applicable to all vessels, from 400 tons upwards, and that the proportion of one horse power to 25 tons will propel a vessel in a calm at the rate of 5 knots per hour. He then institutes a comparison between the time occupied by the ship "Vernon," fitted with auxiliary steam power, on her voyage from London to Calcutta, and that of the steam ship "India," which performed the same voyage about the same period. The expenses attendant upon the employment of auxiliary steam power in the "Vernon" during this voyage are stated to have been £600; whilst the expenses attendant upon the "India" for the same period are estimated at £4293, showing an excess of expenditure over that of the "Vernon" of £3693. The comparative rate of the vessels in point of speed, as stated by Mr. Seaward, appears by no means favourable to the "India;" but, as we know the "India" to have been detained for a considerable period at the Cape by stress of weather, and as we conceive there are evidences of some slight prejudice against the "India," in consequence, we presume, of her being a Clyde-built vessel, we attach but little value to this part of the statement.

Mr. Seaward's memoir contains much important information, and manifests a familiar acquaintance with the subject of which he undertakes to speak, and the possession of a liberal share of good common sense. It is also well written, though we should have been better pleased with it had there been less straining after rhetorical decoration; a serious fault in any paper which professes to treat of practical and scientific subjects, especially when addressed, not to the herd of mechanical amateurs, or scientific cyphers, but to an association of able and practical men. Another fault which pervades the work, is the frequency of reference to, and of involved commendation of, the Messrs. Seawards' engineering performances. We hear a great deal too much of the excellencies of the "Gem" and the "Ruby," and we find those vessels and the "Brunswick," the latter a work also of Messrs. Seaward's and a comparative failure, associated with and obtaining the precedency over the "Eclipse," the "Blackwall," and the "Railway," vessels by which, in point of speed, they are entirely outstripped. Such preferences as these manifest an unbecoming partiality, as ill-judged as it is impotent; and are equally unworthy of those by whom such communications are accredited as of those by whom they are rendered.

In conclusion, Mr. Seaward observes that he has avoided all recondite calculations, with a view of meeting more effectually the objects of practical men. He further informs us, that theoretical calculations upon such a subject as that he has undertaken to handle, however suited to the philosopher's study, are of little value to the practical engineer or ship builder; and he quotes the language of the late President of the Institution of Civil Engineers, to the effect that, what is wanted for that society is the development of that knowledge which is founded upon practical experience. From this intimation we might infer that, in the opinion of this gentleman, science is incapable of rendering any aid to the practical mechanist, but that he would be prepared to go into the most recondite computations, were such a course desirable. In reference to the first allegation, it is only necessary to observe that, in the development of that knowledge which is founded upon practical experience, science is the most efficient instrument; in proof of which fact, we might refer to the extraordinary development the arts have experienced since their progress has been aided by the light of science, as compared with their stationary condition when they were merely empirical. As regards the second implied allegation, namely, that Mr. Seaward would be prepared to enter into extremely recondite calculations respecting the subject of his memoir, except for the weighty reason he has given, we can only admire the discretion which dictated so much forbearance. If it be Mr. Seaward's desire to maintain his reputation for profundity, he will best accomplish his object by avoiding all attempted manifestation of it. The only attempt of this description in the memoir before us is in the 4th page, where we are told that "the employment of a quadruple amount of steam power would not double the speed, although in theory this is assumed to be the fact." By whose theory is this assumption made? We presume that it must be of Mr. Seaward's own fabrication, and his exclusive property, it being the theory of other engineers that the resistance increases as the square of the velocity, and the power necessary to overcome that resistance, as the cube of the velocity. And the reason is obvious. If the power be doubled, the resistance is quadrupled; the force of the engine, therefore, to overcome this resistance, must be quadrupled also, and must act with a double speed. In other words, when the speed is doubled, the power requisite to maintain that speed has to be increased eight times instead of four times, as by the *theory* of Mr. Seaward.

A Treatise on the Application of Marine Surveying and Hydrometry to the practice of Civil Engineering. By DAVID STEVENSON, Civil Engineer. Adam and Charles Black, Edinburgh, 1842.

THE author here treats on a branch of surveying which has always been very imperfectly handled in works professing to convey information on this subject. The quaint and pithy directions of old writers, when they come to show the manner of surveying the coasts of harbours and rivers, will seldom fail to elicit a smile from the professional surveyor, at the idea that such directions would ever enable any one to perform what they are intended to teach; and scarcely less will he be moved by a mingled feeling of pity and ridicule for any unfortunate would-be surveyor, who, deeply read in the mystic lore of some ancient authority, should sally forth, in all confidence, to the task of performing a difficult river or harbour survey. Were it not that the practice and the knowledge of surveying are confined to a comparatively small number of persons, and that, consequently, errors which are made in surveys, and bungling, roundabout ways of proceeding are not often observed, we should undoubtedly have evidence enough to prove the necessity of practical information on a subject of such importance. If we could lay bare the secret trembling anxieties, the harassing emotions, the suppressed fears and doubts on the ultimate success and accuracy of his work, which torture the young surveyor in his hours of arduous application, whether in the field, poring over his theodolite and the hieroglyphics of his field-book, or in the house, straining over the net-work of his survey, as by slow degrees he develops it on the paper, we should even feel that a boon is conferred on humanity by a production which reduces to order and simplicity the details of a task calculated to puzzle, in no small degree, the ardent hasty brain of a youthful student. We therefore hail the book before us, judging from its title alone, and supposing it to have any merit at all, as a welcome accession to the engineer's library; our expectations also, on a first glance, were not diminished when we recognized its author to be the same Mr. Stevenson who favoured the profession not long since with an instructive work on the Civil Engineering of North America. Mr. Stevenson also boasts of a name not less celebrated in Scotland than that of his namesake in England, the father of Mr. David Stevenson being universally known as the engineer of the Bell Rock Light House, and many other important works.

On attentively examining this book, we find that our expectations have been amply realized—we find it to be the production of one who thoroughly understanding the subject on which he writes, falters not, hesitates not, shrinks not from writing freely for fear of exposing his ignorance, resorts to no paltry expedients for filling up his book with mere words enveloping ideas like needles in hay; but who, in a clear, lucid, easy, and familiar style describes the manner of conducting the survey of a river or harbour, from beginning to end. The first two chapters are devoted to triangulation, and to the choice and measurement of a base line. It seems from these that the author adopts the method of connecting the two banks of the river by a series of angles taken from each station. The stations are at short distances from each other, and the construction lines of the survey change their direction at every station. Thus no line along the banks of the river is longer than the distance between two of the principal stations; and thus, when the construction lines are laid down, they form a series of triangles erected on each base from station to station, and having their vertices in opposite stations on the other side of the river. It is well known to most of our readers, that there are various methods of arranging the construction lines in surveying; and the one which is most strictly correct in a geometrical sense is undoubtedly that in which the whole work is enclosed by some large triangle, or at least entirely intersected by one or more straight lines, on which triangles are constructed as large as the extent of the work may require. The beautiful accuracy with which all the parts of a survey executed in this manner fit into each other; the strict tying of the work together; the admirable system of proofs and checks afforded; and the distribution of minute error arising from imperfect chaining, while any error of consequence is at once discovered at the precise spot where it occasions distortion;—all point out the method of surveying within long construction lines as the very best that can be adopted for all ordinary surveys of land. But in the case of rivers and coasts there are many practical objections to this method, arising from the difficulty of measuring long straight lines on the shore or margin sufficiently near the water to furnish the necessary offsets, and from the impracticability of measuring the numerous lines which would be required across the river, or which would be required to extend out to sea, supposing the system followed in the survey of a single line of coast. Hence in marine surveys the necessity of employing the theodolite or some other instrument for measuring angles is universally admitted; and this point being settled, the next consideration is that of determining the form and position of the series of triangles which, depending on each other and constructed in the manner of a continuous net or framework, constitute the basis for finding the main points and filling up the whole detail of the survey. The two first chapters afford some useful practical information, as to the best method of observing the angles and constructing these important lines.

The third chapter is devoted to tide observations, the author strongly insisting on the importance of these being correctly made at many different points, in consequence of the irregular level assumed by the tide wave at different parts of its course up the river. Some very curious and important details are given in this and the following chapter on soundings, relative to the inclined surface presented by the water in tidal rivers at different times of the tide. Thus in the river Lune, the current of which runs from Lancaster to Glasson, the level of low water during a spring tide was found to be 11 ft. lower at the latter place than at Lancaster. Also at the same instant of time, when it was low water at Lancaster, the level of water at Glasson was 4 ft. 4 in. above low water mark at Lancaster. On the river Dee the level of low water mark at Flint was 7½ ft. below the low water mark of the same tide at Connah's Quay, only 2⅔ miles higher up the river. And at the moment of low water at Connah's Quay, the water at Flint was 5½ ft. above low water mark at Connah's Quay. These are only a few examples of the irregularity of level presented by the surface of water in tide rivers: in the course of the book there are many such examples, extending through both spring and neap tides. They prove in the most decided manner—1st. that it is an egregious error to assume the low water mark at different points on the same river to be on the same level; and, 2nd. that it is almost equally erroneous to suppose that at any given instant of time the level of water in a river is the same at two distant points. A difference of level, also, prevails in the high water mark of the rivers Dee, Lune, and Forth, from all of which actual observations are detailed; but this difference is not to such an extent as that in the level of the low water marks, although in other rivers it is possible that the line drawn through the high water marks of the same tide may be as much inclined as the line drawn through the low water marks. We have not unfrequently seen cases of disputed levelling, only in consequence of erroneous ideas as to the contemporaneous level of tide water, and as to the level of high and low water mark at different points of a river; and doubts have often been thrown, in consequence, upon the accuracy of a section taken across a district of country, from one point of a river to another, or even from one river to some other river in another part of the country. The faith of engineers, however, in the ancient errors with regard to the tides which we have mentioned, has been already somewhat shaken, and the practical information contained in the book before us will, we trust, explode them entirely, even if it should fail to establish any sound theory on the ruins of the old hypotheses.

In the 5th and 6th chapters Mr. Stevenson resumes the subject of the actual survey of the river, treating first of the low water survey, which embraces the sand banks, shoals, and other parts of the bed, which are dry at low water, and then of the high water margin, the method of proceeding to the best advantage being pointed out as to both these parts of the survey. We regret that our space will not admit of an extract sufficient in length to do justice to the author's views and explanations in this part of the work; we must, therefore, refer our readers for further information to the book itself.

The next chapter, on cross sections and borings, is interesting and useful, as exhibiting the most direct manner of proceeding to make sections across the river, at places where they are necessary to show the inequalities and structure of the bottom, and to point out the parts to be excavated in order to obtain sufficient depth of water in the channel. Mr. Stevenson justly observes that "much time may be lost in making the sections and borings, and erroneous data may be obtained if the operation be not gone about in a proper manner."

Chapter 8 relates to hydrometrical observations, principally on the velocity of currents at the surface, and the bed of their course. For the purpose of determining the mean velocity from the observed surface velocity, Mr. Stevenson gives the following formula, founded on a rule of De Buat:

$$\gamma = \frac{a + (\sqrt{a - 1})}{2}$$

where $a =$ the observed surface velocity, and $\gamma =$ the mean velocity sought.

The concluding chapter, relating to the protraction of the lines in the survey, and of the soundings, completes the subject, and although this part is equally valuable, and in its mode of treatment equally practical with the rest of the book, it would convey little or no information to make isolated extracts from it. The whole, however, is well worthy the attention of every engineer and surveyor engaged in the prosecution of marine surveying, to all of whom it may be said, without derogation of their skill, that however practised or proficient they may be in this part of the profession, this book is calculated to add to their knowledge of the subject. The work contains numerous plans and sections of rivers, showing the mode of surveying and of representing the cross sections and borings, also examples of the manner of keeping the field books in the different stages of the survey.

BOOK MAKING.

SIR—I beg leave to trouble you with a few remarks respecting a recent publication, with the view of calling your attention to a highly reprehensible practice, which is now becoming common in this class of works. The practice I allude to is the copying and inserting, in several different publications, the same cuts and impressions. In a small work lately published, entitled "Anglican Church Architecture, &c." naturally supposing that the wood cuts and illustrations (with which the volume is rather copiously furnished) were examples not before published, but had been collected by the author to illustrate and support the opinions put forth in his work, I was induced to become a purchaser; but on looking over the book, I was much surprised to find that almost without exception the cuts, &c. were fac-similies of those published in a recent work entitled "The Glossary of Architecture," and as both proceed from the same publisher, I have no doubt the same blocks did duty a second time. It may be said that the work I now refer to is small in price, but the principle is equally bad, whatever may be the cost of the publication; and I hope that you will, by making instances of this sort of book-making public, prevent a practice so vicious in principle and so hurtful in its effects from becoming general. If persevered in, it cannot fail to destroy that confidence which should always subsist between the author and the purchaser of his work.

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ON SPIRES.

We have already borrowed largely from the Penny Cyclopædia, on the subject of staircases, and now similarly avail ourselves of the article "Spire," which is certainly the most complete and most original we have ever yet met with. In fact, scarcely anything at all relative to spires is to be found in preceding publications,—not even in those which profess to be strictly architectural. They give us little more than an explanation of the term, and some not even that; at least, such is the case with Nicholson's Architectural Dictionary, where, unaccountable as it may seem, the word "Spire" is altogether omitted! Besides calling attention to a variety of interesting particulars that seem to have entirely escaped the observation of others, the writer of the article in the Penny Cylopædia has suggested several new and expressive terms that, in our opinion, are well worthy of being generally adopted. We are aware that some persons object to any innovations of the kind, yet if they are found to be really useful, and to enrich the terminology of the art, there can be no impropriety in adopting them; neither is there any greater difficulty attending the introduction of them than arises from the attempt to revive terms which have become so entirely obsolete, that their original meanings can now only be vaguely guessed at, so that there is danger of the terms so rescued from oblivion being applied very differently from what they were while they were in use.

"Spire (in German *Spitze*, or *Thurm-Spitze;* in French, *Flèche*, from its resemblance to the pointed tip of an arrow; but the Latin *spira* signifies a coil, or spiral line, and not an upright cone or pyramid). The term belongs to Gothic architecture, and is used to designate the tapering pyramidal mass erected on a tower by way of finish and ornament. That so little relative to spires is said in works on Gothic architecture is the more remarkable, because, in proportion to the number of examples, they exhibit more variety than almost any other separate feature in edifices in that style. Though the spire is a very striking feature in a building, it has nothing to recommend it on the score of direct utility. It is a mere external appendage to an edifice, since it does not, like the dome, contribute to any kind of effect whatever internally, a circumstance that seems to have been overlooked by Mr. A. W. Pugin, for else he would hardly have made it a reproach against the architect of St. Paul's, that the exterior dome of that fabric is merely for effect. Though the same objection might be made to the spire, we are far from urging it: mere utility is a low test of merit in architecture, and although this merit cannot be claimed for this feature in Gothic architecture, we hold the spire to be one of paramount value in it, inasmuch as that pyramidal figure concentrates all its principles and characteristics, rendering it most eminently the *Pointed* style. So considered, the spire may be said to be the keystone of the whole idea of such style;—that which visibly completes it. It serves, moreover, to impart an air of graceful lightness to the whole of a building, and to correct—if we may so express it—what might else be excess of length as compared with the general height of a structure, by giving a corresponding degree of loftiness to one portion of it.

"The origin of the spire, like that of the pointed arch, is merely matter of conjecture. The probability is that it arose out of the peaked roof usually given to campaniles and towers of a preceding period, which form was afterwards gradually improved upon and refined, till it eventually grew up into the slender tapering spire. According to such supposition, we would refer to the tower of Than church in Normandy, as an example exhibiting the rudiments of the spire, it being no more than a steep peaked roof or low pyramid, whose height does not exceed three-fourths of its base. A *peak* of this kind differs also from the spire, both in being the same in plan as the tower on which it is placed, and in being immediately set upon it, whereas the spire is almost invariably an octagon or other polygon, and is surrounded at its base with a parapet. In Italy, where campaniles are usually detached square towers of very slender or lofty proportions, the spire is almost unknown, for such towers have seldom more than a mere pyramidal roof or peak, which, though it may be considered as the germ from which the Gothic spire was afterwards developed, is in itself of quite different character; yet, at the same time, that of each is best adapted to the respective style. There are some few instances of square spires; among them a very singular one at Egeln in Germany, where two such spires are set immediately together upon the same tower. But however slender in their proportions such spires may otherwise be, they have a certain heavy massiveness of form. When therefore, greater loftiness and lightness were aimed at in this feature, the adoption of a polygonal plan for it became almost matte of course, for although in a geometrical drawing the general outline and proportions of a spire are the same whether it be square or octangular in plan, the perspective or actual appearance is widely different; because in the latter case the diagonal breadth of the square tower below is cut off, and each side or plane of which the spire is composed becomes a much more pointed triangle. Besides which, the polygonal spire produces a degree of contrast and variety highly favourable to general effect in the pointed style."

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"There are so many peculiarities in spires, that it is highly desirable to have descriptive terms for them. First, as regards its base, a spire may be said to be *Cluster-based*, when surrounded below with pinnacles connected with it, and from among which it seems to spring up; of which kind St. Mary's Oxford, is a celebrated example. The Hôtel-de-Ville, at Ypres, has a spire clustered with four exceedingly tall pinnacles or lesser spires. Where there are windows placed *against* a spire, rising *upright* like the dormers or lucarnes on a foro, the term *Lucarned* would express that character; we have therefore not scrupled to make use of it in the annexed table of spires, where it is applied, among others, to those of Lichfield cathedral, which have several tiers of such windows, and are described accordingly. *Crocketted* and *Banded* are terms requiring no explanation; but in regard to the first it may be remarked, that spires, otherwise quite plain, are sometimes ornamented with *crockets* along their edges; and with respect to *bands*, they are sometimes little more than string mouldings, but in other cases broad and enriched surfaces. Many of the spires in Normandy are ornamented with such a number of bands, that they form alternating courses with the plain spaces between them. *Finialled* is a term which does not apply to any of our English spires; but that of St. Stephen's, Vienna, and some other continental spires, have an exceedingly large and rich finial, which ornament gives them a particular boldness of expression. The *Tabernacle-spire* also is one of which there is no example in this country, but of which the one just mentioned, and those of Strassburg, Ulm (as designed), Thann in Alsace, and many others, are specimens, the tower and spire being carried up from the ground in a succession of diminishing stages, all profusely adorned with pannelling, niches, canopies, pinnacles, and other tabernacle-work, in such a manner that it is barely possible to distinguish where the upright portion or tower terminates, and the spire itself begins, the latter seeming little more than the uppermost stage in continuation of the rest. Neither have we any instances of *Open-work* spires, or of such as, if not actually perforated, are yet entirely covered with tracery. That at Freyburg, and those at Burgos and Batalha, are all exceedingly rich specimens of the kind. The chapter-house of Burgos also has a series of very large pinnacles or small spires of tabernacle character. Cambrai and Esslingen on the Neckar afford other examples of open-work spires.

"There are various other circumstances which, though they do not affect the spire itself, produce greater or less difference in regard to the character of the structure of which it is a component feature. Very much, for instance, depends upon its situation in the general plan: at Salisbury, Norwich, and Chichester, the spire is raised upon a tower at the intersection of the cross, or in the centre of the plan; whereas in most continental cathedrals and large churches there are two spires on the towers of the west front, though in some instances (Strasburg, Antwerp) only one has been erected. Several, however, have a single tower and spire in the centre of the west front (Ulm, Freyburgh, Thann in Alsace), in which case the tower itself begins to diminish almost from the ground, and the whole becomes what we have described as of the *tabernacle* character. In most of our English churches (not cathedrals,) the spire is placed upon a tower at the west end, as at Grantham, Louth, Bloxham, &c. If we except Peterborough, where they are very diminutive, the only English cathedral which has two western spires is Lichfield, which is further remarkable as having a central tower and spire also. Besides the richness and variety thus produced, the larger central spire serves to balance the whole composition, whereas else the body of the structure is apt to look low in comparison with the west end. At St. Stephen's, Vienna, the tower and spire are singularly placed on the south side of the edifice, it having been intended to balance them by a corresponding tower on the north side. At Gelnhausen, on the contrary, there is a group of spires, as already noticed, at the east end."

Having extracted so largely from this article, we must refer our readers to the Penny Cyclopædia itself for the remainder, transferring to our own pages the annexed Table:—

Table of Spires, English and Foreign.

	Tower.	Spire.	Total Height.	Remarks.
Old St. Paul's	260	274	534	Six diameters high.
Salisbury	207	197	404	Date about 1350. Three enriched bands. Nearly five diameters.
Norwich	140	163	303	Plain, rather more than five diameters high.
Lichfield	114	138	252	Lucarned, 5 tiers of windows. Nearly 5 diameters high.
Do. two western	89	103	192	Lucarned, 4 tiers; 4½ diameters high.
Chichester	..	..	270	Pinnacled and lucarned below; banded with one broad rich band; else quite plain.
Oxford Cathedral	94	52	146	Date about 1220.
Oxford, St. Mary's	86	94	180	Spire itself quite plain, lucarned with a canopied window below, on four sides. Embased by very rich canopied niches and pinnacles.
Louth	148	140	288	Embased with lofty pinnacles and flying buttresses. Crocketted. 6 diameters.
Grantham (about)	140	..	250	Lucarned, crocketted, large crocketted pinnacles at base. Base of spire less than tower.
Newark	..	..	..	Short spire, spreading out at its base. Lucarned, with 4 tiers of windows.
Bloxham	101	94	195	A very beautiful example. Spire 5 diameters high. Date about 1350.
St. Michael's, Coventry	136	164	300	This tower and spire a very fine example.
St. Mary's, Stamford	..	..	..	Date about 1260. Base without parapet or pinnacles. Lucarned, 4 tiers. Spire 2½ diameters.
Welford, Gloucester	..	..	..	An example of a spire on a low circular tower. Lucarned at its base with lofty gabled windows. Spire 3 diameters.
St. Chad's, Birmingham	88	62	150	Two west towers, only N.W. spire yet erected. (*Comp. to Almanac*, 1842.)
Cologne (as designed)	330	200	530	Two west spires enriched with tracery, and crowned by large finials.
Strasburg	364	110	474	Two west towers, only N.W. spire.
St. Stephens, Vienna	285	180	465	On south *side* of church. Example of a tabernacle tower and spire.
Ulm (as designed)	320	171	491	Tabernacle example. Tower and spire in centre of west front.
Freyburg	221	159	380	Rich open-work spire. Tower and spire in centre of west front.
Marburg	184	88	272	Two west towers and spires. Base of spire gabled. Spire 4½ diameters.
Nürnberg, St. Laurence	180	90	270	Do. do. do.
Nürnberg, St. Sebaldus	170	90	260	Do. do. do.
Thann in Alsace	..	..	..	A tabernacle example, with rich tracery-work on spire. Spire about one-fourth of entire height.
Antwerp	..	..	366	Two west towers, only N.W. spire.
Chartres	..	..	..	Two west spires, the N.W. one loftier and more enriched than the other.
Bayeux	142	104	246	Two west spires. The N.W. spire has 6 broad bands; the other plain. Diameter at base 27 feet.
Caen, St. Stephen's	155	107	262	Lucarned at base and banded.
Caen, St. Peter's	134	110	244	Base of spire 24 feet. Spire has 9 bands, with small hexafoil, quatre-foil, and trefoil apertures between them. Crocketted.
Batalha	113	57	170	Very rich open-work spire. Diameter at base 19 feet.
Burgos Cathedral	..	..	..	Two short or stump but very rich open-work spires, at west end. Date of spires 1442.
Glasgow	115	105	220	Lucarned, banded, lower band richly moulded and quatre-foiled, and surmounted by fleurons. Diameter at base 27 feet.
Treves on the Moselle	111	128	239	A new church, finished 1831. Lassaulx, architect. Spire, a *broach*, splayed off at base. Diameter, above splay, 16 feet; height about 8 diameters.
St. Marie Hilf, Münich	220	60	280	Church erected by Ohlmuller; completed 1839. Spire an open-work *helm* or broach.

ON WARMING AND VENTILATING THE REFORM CLUB.

Report on the Apparatus erected in the Reform Club House, for Warming and Ventilating its several Apartments. By Andrew Ure, *M.D., F.R.S., Professor of Chemistry.*

There are two general plans in use for at once diffusing heat, and renewing the air in extensive buildings, which plans differ essentially in their principles, modes of action, and effects. The oldest, and what may be called the *vulgar* method, consists in planting stoves in the passages or rooms, to give warmth in cold weather, and in constructing large and lofty chimney-stalks to draw air in hot weather out of the house, by suction, so to speak, whereby fresh air flows in to maintain, though imperfectly, an equilibrium of pressure. In apartments thus warmed and ventilated, the atmosphere is necessarily rarer than it is out of doors, while, in cold weather, the external air rushes in at every opening and crevice, of door, window, or chimney—the fruitful source of indisposition to the inmates.

The evils resulting from the stove-heating and air-rarefying system, were, a few years ago, investigated by me, in a paper read before the Royal Society,* and afterwards published in several scientific and technological journals. It is there said, that the observations of Saussure, and other scientific travellers in mountainous regions, demonstrate how difficult and painful it is to make muscular or mental exertions in rarefied air. Even the slight rarefaction of the atmosphere, corresponding to a low state of the barometer at the level of the sea, is sufficient to occasion languor, lassitude, and uneasiness, in persons of delicate nerves; while the opposite condition of increased pressure, as indicated by a high state of the barometer, has a bracing effect upon both body and mind. Thus, we see how ventilation, by the powerful draught of a high chimney-stalk, as it operates by pumping out, exhausting, and attenuating the air, may prove detrimental to vivacity and health; and how ventilation, by forcing air in with a fan or a pump, is greatly to be preferred, not only for the reason above assigned, but because it prevents all regurgitation of foul air down the chimneys, an accident sure to happen in the former method. Genial air thrown in by a fan, in the basement story of a building, also prevents the stagnation of vapours from damp and miasmata, which lurk about the foundations of buildings and in sewers, and which are sucked in by the rarefying plan. Many a lordly mansion is rendered hardly tenantable from such a cause, during certain vicissitudes of wind and weather.

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* I had been professionally employed by a Committee of the Officers of the Custom House, to examine the nature of the malaria which prevailed there, but I had no concern in erecting the stoves which caused it.

The condensing plan, as executed by the engineers, Messrs. Easton and Amos, at the Reform Club House, consists of a large fan, revolving rapidly in a cylindrical case, and is capable of throwing eleven thousand cubic feet of air per minute, into a spacious subterranean tunnel under the basement story. The fan is driven by an elegant steam engine, working on the expansion principle, of five horses' power. It is placed in a vault, under the flag pavement, in front of the building; and as it moves very smoothly, and burns merely cinders from the house fires, along with some anthracite, it occasions no nuisance of any kind. The steam of condensation of the engine supplies three cast iron chests with the requisite heat for warming the whole of the building. Each of these chests is a cube of three feet externally, and is distributed internally into seven parallel cast iron cases (somewhat like empty portfolios), each about three inches wide, which are separated by parallel alternate spaces, of the same width, for the passage of the air transversely, as it is impelled by the fan. This arrangement is most judicious, economizing fuel to the utmost degree; because the steam of condensation which, in a Watt's engine, would be absorbed and carried off by the air-pump, is here turned to good account, in warming the air of ventilation during the winter months. Two hundred weight of fuel suffices for working this steam engine during twelve hours. It pumps water for household purposes, raises the coals to the several apartments on the upper floors, and drives the fan ventilator. The air, in flowing rapidly through the series of cells placed alternately between the steam cases, cannot be scorched, as it is infallibly with air stoves; but it is heated only to the genial temperature of from 75° to 85° Fahr., and it thence enters a common chamber of brickwork in the basement story, from which it is let off into a series of distinct flues, governed by dialled valves or registers, whereby it is conducted in regulated quantities to the several apartments of the building. I am of opinion, that it would not be easy to devise a better plan for the purpose of warming and ventilating a large house; and I am only sorry to observe, that the plan projected by the engineers has been *injudiciously* counteracted in two particulars.

The first of these is, that the external air, which supplies the fan, is made to traverse a great heap of coke before it can enter that apparatus, whereby it suffers such friction as materially to obstruct the ventilation of the house. The following experiments, which I made recently upon this point, will place the evil in a proper light. Having fitted up Dr. Wollaston's differential barometer, as an anemometer, with oil, of specific gravity 0·900 in one leg of its syphon, and water of 1·000 in the other, covered with the said oil in the two cisterns at top, I found that the stream of air produced by the fan, in a certain part of the flue, had a velocity only as the number 8, while the air was drawn through the coke, but that it had a velocity in the same place, as the number 11, whenever the air was freely admitted to the fan by opening a side door. Thus, three-elevenths, both of the ventilating and warming effects of the fan, are lost. I cannot divine any good reason for making the Members of the Reform Club breathe an atmosphere, certainly not improved, but most probably vitiated, by being passed in a moist state through a porous sulphureous carbon, whereby it will tend to generate the two deleterious gases, carbonic oxide and sulphuretted hydrogen, in a greater or less degree. It is vain to allege that these gases may not be discoverable by chemical analysis—can the gaseous matters which generate cholera, yellow-fever, or ague, be detected by chemical re-agents? No, truly; yet every one admits the reality of their specific virus. I should propose that the air be transmitted through a large sheet of wire-cloth before it reaches the fan, whereby it would be freed from the grosser particles of soot that pollute the atmosphere of London. The wire-cloth should be brushed every morning. The second particular, which counteracts in some measure the good effects of the fan in steam ventilation—is the huge stove placed in the top story of the building. This potent furnace, consuming, when in action, 3 cwt. of coals per day, tends to draw down foul air for its own supply from the chimneys of the adjoining rooms, and thus to impede the upward current created by the fan. I have measured by Dr. Wollaston's differential barometer the ventilating influence of the said furnace stove, and find it to be perfectly insignificant—nay, most absurdly so—when compared with the fan, as to the quantity of fuel which each requires per day. The rarefaction of air in the stove chamber, in reference to the external air, was indicated by a quarter of an inch difference of level in the legs of the oil and water syphon, and this when the door of the stove-room was shut, as it usually is; the tube of the differential barometer being inserted in a hole in the door. The fan indicates a ventilating force equal to two inches of the water syphon, which is twenty inches of the above oil and water syphon, and therefore eighty times greater than that of the stove furnace; so that, taking into view the smaller quantity of fuel which the fan requires, the advantage in ventilation in favour of the fan is the enormous ratio of 120 to 1, at the lowest estimate. The said stove in the attic seems to me to be not only futile, but dangerous. It is a huge rectangular cast iron chest, having a large hopper in front kept full of coals, and it is contracted above into a round pipe, which discharges the burnt air and smoke into a series of horizontal pipes of cast iron, about four inches diameter, which traverse the room under the cieling, and terminate in a brick chimney. In consequence of this obstruction, the draught through the furnace is so feeble that no rush of air can be perceived in its ash pit, even when this is contracted to an area of six inches square; nay, when the ash pit was momentarily luted with bricks and clay, and the tube of the differential barometer was introduced a little way under the grate, the level of the oil and water syphon in that instrument was displaced by no more than one-tenth of an inch, which is only one-hundredth of an inch of water—a most impotent effect under a daily consumption of 3 cwt. of coals. In fact, this stove may be fitly styled an *incendiary coal devourer*, as it has already set fire to the house; and though now laid upon a new floor of iron rafters and stone flags, it still offers so much danger from its outlet iron pipes, should they become ignited from the combustion of charcoal deposited in them, that I think no premium of insurance adequate to cover the imminent risk of fire. The stove being, therefore, a superfluous and dangerous nuisance, should be turned out of doors as speedily as possible. Its total cost, with that of its fellow in the basement story, cannot be much less than the cost of the steam engine, with all its truly effectual warming and ventilating appurtenances.

I take leave to observe, that the system of heating and ventilating apparatus constructed by Messrs. Easton and Amos in the Reform Club House, offers one striking and peculiar advantage. It may be modified at little expense, so as to become the ready means of introducing, during the sultriest dog-days, refreshing currents of air at a temperature of 10, 20, 30, or even 40 degrees under that of the atmosphere. An apparatus of this nature attached to the Houses of Parliament and Courts of Law would prove an inestimable blessing to our legislators, lawyers, judges, and juries. Of such cool air a very gentle stream would suffice to make the most crowded apartments comfortable, without endangering the health of their inmates with gusts of wind through the doors, windows, and floors.

It is lamentable to reflect how little has been done for the well-being of the sentient and breathing functions of man in the public buildings of the metropolis, notwithstanding our boasted march of intellect and diffusion of useful knowledge. Almost all our churches are filled on Sundays with stove-roasted air; and even the House of Commons has its atmosphere exhausted by the suction of a huge chimney stalk, with a furnace equal, it is said, to that of a 40-horse steam boiler. To gentlemen plunged in air so attenuated, condensation of thought, and terseness of expression, can hardly be the order of the day.

Nearly seven years have elapsed since I endeavoured to point public attention to this important subject in the following terms:—"Our legislators, when bewailing, not long ago, the fate of their fellow-creatures doomed to breathe the polluted air of a factory, were little aware how superior the system of ventilation adopted in many cotton mills was to that employed for their own comfort in either House of Parliament. The engineers of Manchester do not, like those of the metropolis, trust for a sufficient supply of fresh air into any crowded hall, to currents physically created in the atmosphere by the difference of temperature excited by chimney draughts, because they know them to be ineffectual to remove, with requisite rapidity, the dense carbonic acid gas generated by many hundred powerful lungs."*

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* Philosophy of Manufactures, p. 380, published by Charles Knight. London, 1835.

At page 382 of the work just quoted there is an exact drawing and description of the factory ventilating fan.

On the 6th of June, 1836, I took occasion again, in a paper read before the Royal Society, upon the subject of the *malaria* which then prevailed in the Custom House, to investigate the principles of ventilation by the fan, and to demonstrate, by a numerous train of experiments, the great preference due to it, as to effect, economy, and comfort, over chimney-draught ventilation. Yet at this very time, the latter most objectionable plan was in progress of construction, upon a colossal scale, for the House of Commons. About the same period, however, the late ingenious Mr. Oldham, engineer of the Bank of England, mounted a mechanical ventilator, and steam chest heater, for supplying a copious current of warm air to the rooms of the engraving and printing departments of that establishment. Instead of a fan, Mr. Oldham employed a large pump to force the air through the alternate cells of his steam chest. He had introduced a similar system into the Bank of Ireland about ten years before, which is now in full action.

About two years ago, Messrs. Easton and Amos were employed to ventilate the letter carriers' and inland office departments of the General Post Office, of which the atmosphere was rendered not only uncomfortable, but insalubrious, by the numerous gas lights required there in the evenings. This task has been executed to the entire satisfaction of their employers, by means of fans driven by steam engine power. The said engineers made, about the same time, a set of machinery similar to that erected at the Bank of England, for warming and ventilating the Bank of Vienna. They are justly entitled to the credit of having been the first to execute, in all its bearings, the system of heating and ventilating buildings, having special respect to the health of their inmates, which I urged upon the public mind many years ago.

As fans of sufficient size, driven by steam power with sufficient velocity to warm in winter, and ventilate at all times, the most extensive buildings, may be erected upon the principles above described, without causing any nuisance from smoke, it is to be hoped that the Chapel of Henry VII. will not be desecrated by having a factory Vesuvius reared in its classical precincts, and that the noble pile of architecture of the new Houses of Parliament will not be disfigured with such a foul phenomenon.

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* The following engravings, which we borrow from the *London Journal*, show the construction of the iron cases.

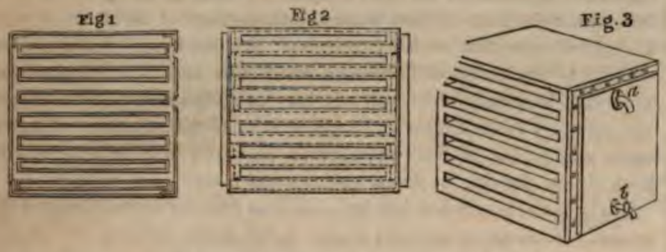

Fig. 1 is a transverse vertical section of the steam chest, for heating the air; fig. 2 is a plan of the same; and fig. 3 is a perspective view, showing the outside casing, also the pipe *a*, for admitting the steam, and the stop-cock *b*, for allowing the condensed water to escape.

ON IRON AS A MATERIAL FOR SHIP-BUILDING.

At the last general monthly meeting of the Liverpool Polytechnic Society, the president, John Grantham, Esq., C. E., read a paper *On Iron as a material for Ship-building*.

Mr. Grantham commenced by stating that it was not without some hesitation he ventured to occupy the time of the meeting with an inquiry into the advantages of using iron as a material for ship-building—an inquiry which was of deep and growing interest, and of great importance to the port of Liverpool. He had sought for practical information from others on the subject, but, having scarcely received any of a practical nature, he determined to take an independent course, and trust to his own observations rather than waste his efforts on a fruitless search. In this he had been materially assisted by the knowledge he possessed of the qualities of iron; and, as a proof of the sincerity of his views, he observed that he had come to the determination, in conjunction with other gentlemen, of engaging seriously in the business of building iron vessels.

It was a mistake to suppose that vessels had only been recently constructed of iron. He was in a position to prove that the construction of iron vessels was not an invention of recent date—that the value of iron in this respect had long been known, and that it had been making a slow but a sure progress towards its present improved state. Iron vessels had been built for the English canals so far back as forty years since, and some of them, he had reason to believe, were still in existence. The first iron vessel that put to sea was built by the Horseley Iron Company, and was called the Aaron Manby, after the name of the projector. She was constructed in the year 1820, and had been at work ever since, without requiring any material repairs. The next iron steam vessel with which he was acquainted was built by the Horseley company under his father's superintendence. She was put together in Liverpool, in the year 1822, and proceeded to her destination, Lough Derg, on the river Shannon. She had been constantly at work ever since, and was at present in good condition. She was now the property of the Shannon company, who had six iron steam vessels at work, all in excellent condition. Several iron vessels had been built in England. The first built in Liverpool was by Messrs. Fawcett & Co., at their boiler yard in Oil Street. One of the vessels built by this company was called the Alburka, and went on Lander's unfortunate expedition to Africa. Several other iron vessels had since been built, of which some of those sailing from Liverpool to Glasgow were most conspicuous. Iron steam vessels had been employed in fighting our battles in the east, among which the Nemesis acted in the Chinese war. The Ironside steamer had been built in Liverpool, and was the first vessel of the kind, of any magnitude, that ever went to sea.

Mr. Grantham then proceeded to describe the ordinary method of constructing iron vessels, which he illustrated by diagrams and models. Iron vessels, he said, were constructed of plates fastened by angle iron ribs placed in different directions. He then described the construction of the keel, the bow, the floorings, the ribs, the platings, and the plan of double and single rivetting. He said that experience alone could decide the question as to the best disposition of the plates. He expressed himself in favour of the lap joint, and said it was groundless to suppose that the rivets could easily be driven out of their places, for, although the head might be removed, the remainder of the rivet was almost immovable. After showing that there existed great facility in applying stringers in iron vessels, he proceeded to make some remarks on the peculiarities possessed by iron vessels, and to institute a comparison between them and timber ones. In the construction of a vessel a builder should study strength, great stowage, safety, speed, durability, lightness of repairs, cheapness, and draft of water. He said he was in a condition to prove that iron vessels possessed all those qualifications in an eminent degree, and that they were superior in those several respects to timber vessels. In the first place they possessed great strength. It had been asserted that iron might answer very well as a material for the construction of small vessels and not very large ones. This, however, was not the case. The country was deprived of some of its finest oaks in order that timber vessels might be constructed, while there was no particular form into which iron could not be moulded by the smiths of England. In the latter case they had no sap to encounter, no knots, no cutting across the grain; and every inch of material was, moreover, of value. It was a well known fact that timber, after having been in use for some time, became brittle and could not be bent; but good iron did not become brittle. The facility for obtaining iron beams in one piece removed many difficulties.

The lecturer next instituted a comparison between the modes of fastening iron and timber vessels, and instanced the case of a copper-fastened timber ship, and the dreadful creaking of timber vessels at sea. He then alluded to the shock which had been some time since received by the Nemesis, and said that if a similar shock had been received by a timber ship the flooring of the latter might have been broken. The damage done to the Nemesis, however, had only amounted to about 30*l*. He said he could relate many other instances of the strength of iron vessels in comparison with timber ships, if time permitted. He next alluded to the qualification of stowage. He said the shell of a timber vessel was greater than that of an iron one, and that while a timber vessel could carry 200 tons, an iron one of similar size could carry 250. In the case of steamers, the comparison was much more in favour of iron as a material for ship building. The qualification of safety was in a great measure identical with strength. In addition to the extraordinary strength of an iron vessel, it would be almost impossible for a fire to take place in the hold if proper precautions were used, and the atmospheric air excluded. After showing the superiority of iron vessels over timber in point of speed, he referred to the qualification of durability, which, he said, involved a chemical question. Upon this subject he had been favoured by Mr. R. Mallett, of Dublin, who had been employed in making experiments for the British Association on the corrosion of cast and wrought iron, with a short paper on the corrosion or fouling of iron ships, which was of great interest, and would be published with the report of the lecture. He then referred to the qualification of durability, and said, that in removing the timber work of the ship John Garrow the dry rot was found. All the timber not exposed to the air had been affected by it, while that exposed to the air was perfectly free from corrosion. The lecturer here exhibited an iron bolt which had been taken out of the John Garrow. The part of it which had been in oak was very much corroded, while the remaining part of it which had been in iron was very little decayed. He was of opinion that oxidation took place no faster on the surface of thick plates than on thin ones, and he did not believe that the thickness of wood had any effect on its durability, so far as decay was concerned. The wear and tear of iron vessels were trifling, while the expense of their repairs was light. In a timber vessel, the expense of repairs would, in the course of ten years, equal the first cost. In the case of an iron vessel no repairs would, in all probability, be required within the first ten years. The expense of keeping the copper of a timber ship in repair would amount to a sum equal to that of making the whole of the repairs required by an iron vessel.

The first cost was the next point for consideration. He wished shipowners to recollect that if they wanted good work they should give a proportionate price, and he hoped in future that they would obtain good work, and not be looking after a saving of expense. He had arrived at the following conclusions, in order to convey some idea on the subject:—that good serviceable iron sailing vessels, of 300 tons, would be equal to timber ships of larger tonnage; that iron vessels had many advantages over timber ones; that for very large vessels iron would be less expensive than timber; and that iron vessels for rivers might be built at a less expense. He laid less stress on the last qualification—that of light draught of water—than on others, but, at the same time, a light draught of water might be obtained in iron vessels. It would be asked, therefore, why not have iron vessels more generally built, if their superiority was so apparent? He would not evade this inquiry, neither would he forbear from alluding to the narrow policy of those who had opposed the system. He admitted that there were some real objections which had to be removed. Those objections had now, however, been set at rest. The difficulty about the compass was one, and it was natural that the derangement of the compass on board of iron vessels would have been a great obstacle; but this question had been entirely set at rest to all reasonable minds. Shipwrights and various other parties had also risen up against iron as a material for ship-building; everything was magnified, and it had been attempted to put it down once and for ever. It was broadly stated that iron vessels would never succeed; and when an iron vessel arrived in the port on one occasion, many went to look at her, and every possible fault was found with her. These objections were now becoming weaker. He thought some blame was attributable to the builders of iron vessels, and he called on builders not to place the principle of iron vessels in jeopardy by constructing vessels which their judgment might tell them would not be serviceable. Underwriters had not been the last to find objection, for shipowners had been told that the premiums would be very high on iron vessels, and that the subject had not been sufficiently tested. The shells which adhered to the bottoms of iron vessels had caused another objection to be raised. There would, however, be no difficulty in removing the shells when first they adhered to the bottoms, if a scraper were used, and this might be done by the sailors when they were at liberty during the voyage. After explaining the manner in which the scraper was to be used, he said that if the vessel were kept clean before she left the port, and the scraper was used at sea, the shells would be removed, and an iron vessel would be kept as clean as a timber one.

The lecturer here expressed a hope that he had satisfied many doubts, and awakened an interest in the breasts of some who never reflected on the subject before. He instanced the fact that chain cables, steam navigation, and many other inventions, had been met with opposition in the first instance, although in general use at present, and he prophesied that such would be the case with reference to iron as a material for ship-building. He said he had a description before him of the "*Great Britain*" steam ship, but that the lateness of the hour prevented him from entering into details. He then referred to the facility which existed for altering iron ships, and said that while the iron could be used again, the fact was otherwise in many cases with respect to timber. He thought there could not be a better period than the present for considering a question of the present kind as a means for alleviating the general distress. If taken up as a national question it would be attended with beneficial results. No one would deny that it was of importance that our ships should be constructed in our own ports, by men of our own population, and with materials of our own soil, which materials were obtainable in the deep recesses of the earth. The iron could be got at the usual market price; there would be an increased demand for labour; and few foreign timber ships could compete with English vessels, as all countries yielded the palm to England in the use of iron. There appeared to him to be only one obstacle to be removed—he alluded to national prejudice. The English public were unwilling to give up their "old wooden walls." It seemed as if they thought their glory would depart if they were to surrender on this point; but it should be remembered that the noblest specimens of naval architecture possessed the seeds of decay, and that the royal heart of oak would remain in the land, if iron were brought into general use. There was one other result which the lecturer noticed, namely, that a 400-ton ship would not produce £200 when condemned and broken up, while an iron vessel, under similar circumstances, at 4*s.* per cwt., would produce 2*l.* per registered ton, or four times as much as a timber ship.

He then concluded by saying that the present was the first time the subject had been fairly before the public, and by hoping that he had advanced it somewhat in the estimation of the meeting, and that in their progress, rise, and end, wooden ships might yield to iron. The reading of the paper, which occupied upwards of two hours, was received throughout with demonstrations of applause and satisfaction.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

Jan. 11.—The PRESIDENT in the Chair.

"*Description of a portion of the Works of the Ulster Canal.*" By Thomas Casebourne, M. Inst. C. E.

The Ulster Canal, which is described in this communication, was designed for the purpose of facilitating the intercourse between the west and the north of Ireland. It commences at the southern extremity of Lough Erne, in the county of Fermanagh, whence it extends for a length of 46 miles, and enters the river Blackwater, near the village of Charlemont, in the county of Armagh, from which there is an outlet through Lough Neagh to the ports of Newry and Belfast. The total cost of this work will amount to about 210,000*l.*, or 4,565*l.* per mile. Allusion is made to a proposed junction canal between the rivers Boyle and Shannon, which may be considered as an extension of the Ulster Canal westward, effecting a junction between all the navigations of Ireland. By its means the produce of the town of Boyle, and the agricultural district around it, would be conveyed directly by steam to Belfast and Newry. At the time of this communication, the Ulster Canal was rapidly advancing towards completion; it was navigable up to Clones, a distance of 40 miles from its commencement, and would be opened to Lough Erne during the summer of 1841. A description is given of the most difficult and expensive portion of the canal, which is situated at about six miles along the line from Charlemont. The length of this part is about three-fourths of a mile, and it comprises seven locks. The expense of construction, exclusive of the value of land, was 17,053*l.* 4*s.* 9*d.*; in order to diminish the expense as much as possible, the canal was contracted in width in two points, where the local impediments were considerable. The transverse dimensions of the canal are, 19 ft. 6 in. at the bottom, 36 ft. at the surface of the water, and 42 ft. at the top bank—giving a slope of 3 to 2 at the sides of the channel. The depth of water is 5 ft. 6 in. in all the reaches, except the summit level, which is capable of containing 7 feet of water. The course of this portion of the line lay along the bottom of a steep ravine in a limestone rock, parallel with the channel of a mill-race adjacent to the river Blackwater. The mill-race was, therefore, diverted into the river between the first and fifth locks of the canal. Between the third and fifth locks the bed of the canal was formed by benching in the rock on one side, and embanking on the other with the materials so obtained. Beyond this it was cut for a distance of nearly 350 yards through the limestone; in one place to a depth of 41 feet. The sides and bed were there lined with puddle, and protected by a facing of rubble wall. Thence, to the seventh lock, the channel was again formed by benching and embanking through a clay soil, where much caution was necessarily exercised in preventing slips at the foot of the embankment, which was subject to inundations from the Blackwater. The masonry was all constructed of limestone from an adjacent quarry. Two appendices are subjoined to this paper. The first of these gives in detail the items of expenditure for the portion of the canal described; the second contains a particular description of the locks and lock-gates, the bridges, and the earthwork. The locks are 73 ft. long, 12 ft. wide, and vary in rise from 6 to 11 feet. They are all constructed in ashlar masonry.—The paper is accompanied by three drawings, descriptive of the general plan and the details of these works, which were originally designed by Mr. Telford, and are now under the direction of Mr. Cubitt. They have been executed almost entirely under the superintendence of the author.

"*An account of the Permanent Way of the Birmingham and Gloucester Railway.*" By G. B. W. Jackson, Grad. Inst. C. E.

The object of this railway is to afford a direct communication between the western and the midland counties of England. The communication describes the course of the line until it reaches Cheltenham, where it joins that which was formerly called the Great Western and Cheltenham Railway, which terminates at Gloucester. Its length is 54 miles. The prevailing inclination is 1 in 300; but on the "Lickey" incline, near Bromsgrove, the rise is 1 in 37 for a distance of 2¼ miles, in ascending which the trains are worked by American locomotives, in addition to the usual train engines. The northern portion of the railway appears to lie on the new red sandstone; then passes to the oolitic formation, on which it terminates. In the former, the principal cuttings are through marl, some of which is exceedingly indurated, and troublesome to work. The principal strata of the latter system are blue and yellow clays. Near Cheltenham, the shifting sand frequently necessitated the use of sheet-piling in passing through it. The waters of Droitwich and Cheltenham were found to possess a saline quality, which rendered them unfit for the use of the engines. That from the surface sand near Cheltenham, however, is exceedingly good.

The building materials employed on this line were—the sandstones of the Lickey and Forest of Dean, the lias of Norton and Wadborough, and the oolites of Cheltenham and Bredon, together with brick, for which earth was readily produced throughout. The cuttings and embankments, with the details of the permanent way, are severally described. The surface width is 30 feet. In the formation of embankments and cuttings, the usual methods appear to have been adopted. In the former, the ratios of the slopes vary between 3 and 2½ to 1; in the latter, between 2 and 1½ to 1. In cuttings, there is a system of drainage beneath the ballast, consisting of longitudinal drains on either side of the line, connected by cross spits, all of which are filled up with broken stones. The rails are supported by chairs and intermediate saddles, which rest on longitudinal balks; and these are bolted to transverse ties. On embankments whose height exceeds five feet, the cross spits, longitudinal balks, and saddles, are all dispensed with. The length of the bearings, the weight, dimensions, &c., of the iron and wood work, with the manner of putting together the whole, are then noticed. The timber employed was, American pine, and English beech, or larch. The various prices are enumerated of the materials and labour for the permanent way, of which the average cost per mile amounted to 5,430*l*. The present condition of the line is stated to be good, and its general working to have been perfectly satisfactory, since its opening in June, 1840.

Subjoined is a description of an artificial ballast obtained by burning clay, which was employed when the country did not afford natural ballast. Its expense slightly exceeds that of the ordinary ballast; blue clay burnt in kilns was found to answer the purpose best, but it does not appear to form a successful substitute for gravel. The results of experiment show it to form a very imperfect drain. The author states that he has always observed the quality of this ballast to suffer in proportion with the quantity of lime contained in it composition.—The paper is accompanied by four drawings, illustrating the construction of the permanent way.

"*Description of a Water-pressure Engine at Illsang in Bavaria.*" By William Lewis Baker, Grad. Inst. C. E.

The machine described in this paper is the most perfect among nine engines constructed by M. de Reichenbach, for the saltworks at Illsang, in Bavaria. These important works are situated in the most southern part of the kingdom; they are supplied from a mine in the valley of Berchtesgacten, and the salt springs at Reichenhalle. The salt was procured from the former in two states,—that of rock salt, which was extracted by blasting, and that of brine. The rock salt was conveyed to Reichenhall, and there underwent the purifying process. But both these methods were attended with disadvantages from the scarcity of fuel; the old method was therefore abolished, and a line of pipes of seven inches diameter was substituted; it was laid between the two places, and extends about 60 miles in length. A series of water-pressure engines, each working a forcing pump, and being themselves worked by a head of water, were placed in convenient situations upon the line. The mine is now worked by forming cavities in the beds of salt, and filling them with water, which soon becomes strongly saturated brine; it is then pumped up, and forced through the pipes to Reichenhalle, where a portion of it is retained, and the rest is sent on to Franenstein, which is at the extremity of the line. At these places, the process of evaporation is carried on, and the salt is manufactured in the usual manner.—The paper is illustrated by a drawing of the engine, showing the details of construction alluded to in the communication.

INSTITUTE OF BRITISH ARCHITECTS.

Feb. 28.—H. E. KENDAL, ESQ. in the Chair.

THE principal business of the evening was to decide on the merits of the drawings and essays submitted to the Institute for their annual prizes.

The Soane Medallion was awarded to Mr. John W. Papworth, associate, for a restoration of Crosby Place, Bishopsgate, as it may be supposed to have existed in the 16th century. To the medallion, a premium of ten guineas has, on this occasion, been annexed, by the liberality of Miss Hackett, the lady to whose antiquarian taste and zeal the public are mainly indebted for the preservation of the Hall, and other remains of this beautiful monument of the domestic architecture of the middle ages.

The medal of the Institute was awarded to an essay*—*On the effects which should result to Architectural Taste, from the general use of Iron in the Construction of Buildings.*" In this essay, (which was read to the meeting,) the writer argued, that a new style of architecture ought to arise from the introduction of a new material, to the extent to which the practical application of cast iron may be, and indeed has already been, carried; and that it is a blot upon the inventive faculties of the age, that art has done little or nothing with a material which has proved of such vast importance in the hands of science. It was further argued, that nothing, probably, but prejudice stands in the way of the development of as much beauty, in a style adapted to the extensive employment of cast iron, as in styles adapted to marble, or any other material. To strike out new combinations and characteristics, the writer did not profess; but that they might be struck out in strict accordance with the principles which govern beauty and taste, he inferred, from the practice of the ancients, who have left us works of art in the most opposite extremes of proportion, and yet equally admitted to be beautiful; the proportions and principles of beauty being governed by the materials in which they are executed, in support of which proposition he cited the candelabra, tripods, chairs, and other works of antiquity in marble and bronze, contrasting the characters of these objects, destined for the same purposes, and exhibiting the same general designs; and that this principle may be carried into architecture, we have also the authority of the ancients, who not only conceived, but systematized a style of architecture of extreme lightness and delicacy, although we do not know that it was ever carried into execution, except with the brush—alluding to the architectural frame-work of the ancient fresco paintings. Instead of working upon such lessons as these, the modern architect has, hitherto, used one of his most important powers in construction only in disguise—misled by pre-conceived ideas on taste. In considering the characteristics of Gothic architecture, which formed a second division of this essay, this practice was shown to be still more absurd, since cast iron lends itself with the utmost facility to this style, especially in its earlier periods, when it appears to have been a principle to reduce the supports, not only apparently, but really, to a minimum, of which the Lady Chapel, of Salisbury, offers proof. In this portion of his subject, therefore, the writer sought to reconcile the use of cast iron with existing principles of taste, and pointed out the peculiar modes which the architects of the middle ages adopted in tracery when executed in metal, as evidenced by the screens of Edward IV. and Henry VII's tombs, contrasting them with modern cast iron window frames modelled upon precedents in stone. The conclusion drawn was, that whenever prejudice shall give way, and iron be recognized as a legitimate resource in art, new architectonic combinations will be produced; and that in Gothic architecture especially, we shall have at our command effects, of which our predecessors could only dream, although they made bold efforts to realize them.

The Honorary Secretary reported, that an answer to the address of the Institute to Prince Albert had been received through the hands of the President, Earl De Grey, and that H.R.H. had been graciously pleased to become the Patron of the Institute.

ARCHITECTURAL SOCIETY.

A CLOSING conversazione of the Architectural Society was held at their apartments, in Lincoln's-inn-fields, on Tuesday evening, March 1st, on the occasion of the juncture of that society with the Institute of British Artists. The rooms were crowded with the leading architects, engineers, and artists of London. The chair was taken by the late president of the Architectural Society, William Tite, Esq. F.R.S., &c.

The chairman prefaced his address by a rapid glance at the state of architecture in England up to the close of the late war, when the opening of the continent furnished the artists with models, and gave a stimulus to their exertions of the most useful nature. The spread of information and of education led to the demand for means of co-operation and combination which the Royal Academy did not furnish, and in consequence, about twelve years ago, the two societies, in connection with architecture, arose. The Architectural Society was first in point of time, but the Institute obtained a charter, and thereby the means of conferring the honorary distinctions of fellow and associate. The plan of the two societies was at first very different, but they had gradually assimilated: and in consequence of a general feeling that a junction was desirable, Mr. Tite was (with the sanction of his Royal Highness the Duke of Sussex, the patron of the Architectural Society) authorised to communicate with Earl de Grey, the president of the Institute on the subject. His Excellency forwarded the suggestion by every means in his power, and after the necessary meetings of the two bodies, the junction was effected early in the last month, the members of the two societies being then united, and the library, casts, and prints will be immediately removed to the rooms of the Institute in Grosvenor-street. Mr. Tite concluded this part of his address by a well-deserved compliment to his Royal Highness the Duke of Sussex for his kind and effective patronage of the society.

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* The essay is anonymous, and no claimant has come forward to receive the medal.

The official part of the president's address having been concluded, he proceeded, in completion of a series of four papers upon the antiquities of Egypt, three of which he had read at previous conversaziones, to give an account of the labours of Colonel Vyse and Mr. Perring in opening and examining all the pyramids of Middle Egypt, thirty-nine in number, from Abon Roach, just north of Cairo, to Illahon, about fifty miles south of that city. All the pyramids of Gizeh Sakkara, and the other interesting sites were explained and elucidated in a most able manner, with the assistance of an exhibition of a large series of the prints and drawings themselves; and every point of interest to the engineer, the architect, and the archæologist was traced out in its turn. The original dimensions of the great pyramid near Gizeh are so vast as to be almost incredible. This pyramid was stated to have been originally 764 square feet at the base, and 480 feet of perpendicular height, covering 13 acres, 1 rood, 22 perches of ground; it consumed 89,028,000 cubic feet of stone, and Mr. Tite stated that it could not now be built for less than 30 millions sterling. The joints of the large casing blocks of granite were so fine as to be scarcely perceptible, not thicker than paper, and the mortar was so adhesive that the stones in some cases broke through their substance rather than give way at the jointing. All the pyramids, with one exception, are due north and south, and are all entered on the north. They are intended as mere mausolia, and generally contained only one sarcophagus each, and rarely more than two. The hieroglyphical discoveries brought to light by these labours, as explained by Mr. Birch, of the British Museum, distinctly showed that the construction of the three great pyramids must be ascribed to a period 2,000 years before Christ, and that they were built by the three kings, Cheops, Cephrones, and Mycerenus, to whom their erection was attributed by Herodotus and the Greeks. The sarcophagus which contained the body of the latter king in the third pyramid, which was richly ornamented, and composed of one block of beautiful basalt, weighing three tons, was removed from the pyramid, and safely placed on board a ship at Alexandria for the British Museum, but she was unfortunately lost near Carthagena, on her way to England, and scarcely a fragment of the ship was seen afterwards, and not a soul was saved to tell the calamity. We have before had occasion to notice the learned and skilful papers of Mr. Tite, and this, like all the preceding ones, was a model of taste and judgment in its arrangement, and skill in its delivery.

After the lecture Mr. Grellier, the late secretary, addressed the meeting. He stated that this evening being the last time of his appearing before them in his official capacity of secretary to the late Architectural Society, he trusted that he might be favoured with their kind attention, while he discharged the pleasing task he had been deputed to perform from the body of gentlemen forming the late Architectural Society—to acknowledge and express to their President, Mr. Tite, the high sense of gratitude entertained towards him, for the kind, able, and efficient manner in which he had discharged, for a period of four years, the duties required of him as President of the late Architectural Society, and as chairman of its several meetings. And as many of the gentlemen present had witnessed his valuable services, and the urbanity he had evinced when presiding at the visitors' meetings, the gentlemen constituting the late Architectural Society had selected the present occasion as being the most appropriate and fitting opportunity of testifying their warmest thanks to Mr. Tite, for his constant and unwearied attention to the duties of his office, which, whether on public or private occasions, he has so zealously and faithfully discharged.

Mr. Grellier then read the following vote of thanks, that has been drawn up:—

ARCHITECTURAL SOCIETY, LONDON,
Instituted A.D. 1831.
His Royal Highness the DUKE OF SUSSEX, K.G., &c., Patron.

The Architectural Society of London, having been recently incorporated with the Royal Institute of British Architects, a meeting of the members of the Society was held at the apartments, No. 35, *Lincoln's Inn Fields, on the* 21*st. February,* 1842, *for the purpose of expressing the high sense entertained by them of the services of William Tite, Esq., F.R.S., &c., their late President, when the following resolution was passed :—*

"That the members of the late Architectural Society, on behalf of that Society, for themselves individually, and particularly on behalf of the students' class—do express to William Tite, Esq. their acknowledgments and thanks for his valuable and efficient services as President of the Society, and as chairman at their several meetings, during a period of four years.

"Also their opinion of the benefits rendered to the profession generally, by his constant exertions to promote the knowledge of Architecture as a fine art, and of those branches of science, which are essential to its practical application."

Signed, by order of the Meeting,
WILLIAM GRELLIER,
Hon. Sec. to the late Architectural Society.

35, *Lincoln's Inn Fields,*
21*st February,* 1842.

The secretary, turning to Mr. Tite, then said, "In the name of the Architectural Society, I have great pleasure in presenting you with this scroll, stating, as you have heard read, the reason why it was presented, and I can assure you that this form has not been selected without due consideration, believing it to be the most agreeable and acceptable to you. In conclusion, I have only to express a hope that in after years, when you may look upon the inscription herein recorded, that while you call to mind the time that you have spent and the labours you have bestowed on behalf of the late Architectural Society, you may also remember that the gentlemen on whom you conferred those favours were neither unmindful of or ungrateful for them."

Mr. Tite acknowledged the compliment in a very feeling manner, and the business of the evening closed.

There were exhibited in the rooms some beautiful drawings and paintings by Messrs. Nixon, B. Moore, and other artists; also a very large drawing of the stained glass now being executed for the north transept of Westminster Abbey, by Messrs. Ward and Nixon. On the table of the second room was a model of the great building now being erected at Liverpool by the corporation, combining under one roof the great St. George's Hall, the assize courts, a large music hall, and various rooms and apartments for corporate purposes. This building is in a rich style of Corinthian architecture; it will be 500 feet long by about 90 feet in width. The architect is Mr. Elmes, jun.

Thus terminated the Architectural Society.

"THE SLIP" ON THE CROYDON RAILWAY.

SIR—I observe that your Journal contains reports of Mr. Vignoles' lectures at the London University College; and as the learned gentleman in some of these lectures indulges rather freely in observations upon the works of his brother engineers, I presume that he will neither be offended nor surprised to find that opinions different from his own are entertained by some, at least, of the numerous class of readers, who, by means of their publication in your Journal, are made acquainted with these lectures of his. To cavil upon minute points of professional practice, would be unworthy any man who considers the circumstances under which a lecturer on engineering comes before the public. I will, therefore, pass over many expressions and many accounts of expedients, some prospective and others retrospective, being already executed, which appear no doubt puerile enough to men who have themselves dealt with the elements, and studied engineering in the capacious school of nature, and come at once to the insinuations of the professor of and concerning "*the slip*" at New Cross on the Croydon Railway.

I find that the learned gentleman and his class, assuming the peripatetic style, have made expeditions in a body to the site of several works of engineering in the environs of London; and that one of these visits was paid to the scene of this celebrated slip, and on that occasion certain remarks were indulged in which I think in no way added to the dignity nor to the accuracy of the lecture. I now quote from your report of the lecture. "The professor then pointed out what he considered to have been the occasion of all the mischief. Nearly all along the slip, the earth had given way at the side of a top drain, parallel with the railway, and in some places it was so apparent, that the declivity looked as if made purposely; this had invariably occurred where there were cross drains from the neighbouring ground (which is considerably elevated), leading into the main drain along the top of the cutting, and which, not being puddled or made water-tight, had allowed the water gradually, and during many months, to insinuate itself into the veins in the clay, and had at length forced the mass out as it appeared."

Now, what is here meant? I am at a loss to understand, from the confused way in which the opinion is expressed, whether Mr. Vignoles asserted that the longitudinal drain along the verge of the slope was not puddled, or that this precaution was omitted in the transverse drains leading into it. If the former of these suppositions expresses what the learned lecturer meant, I beg to assure him, from the evidence of my own eyes, that he is decidedly in error, because every inch of this drain was well and completely puddled; but if he meant that the transverse drains also ought to have been puddled, I would merely observe that he is imposing an unnecessary and entirely useless expense upon the company. Let it be noticed, however, that I would not for a moment think of combatting this or any other opinion of the learned gentleman, did it not involve, in some sort, the professional reputation of the engineer who executed this work, because if it be apparent that puddling ought here to have been resorted to, the engineer is of course to blame for omitting it.

Now to test this opinion, let us observe what difference of effect would the puddling of these drains have occasioned—simply that of preventing the water from penetrating through the bottoms of the drains. But would it have prevented water from penetrating the mass of the hill? Would it have cut off the supply of water from the porous strata where they crop out on the higher lands above? Clearly not. It is obvious that the surface of vegetable mould which covers the hill must be at least as permeable to water as the mass of clay on which the mould rests; yet the whole surface of the hill is to be left unpuddled, and the whole attention of the engineer is to be directed to the object of making the base of the drains water-tight, notwithstanding these drains are all cut into the solid clay.

Mr. Editor, is not this pure nonsense? And what right has a lecturer, advancing such childish notions himself, to convey to his pupils an impression alike unworthy and unjust towards the engineer who executed this work. When the cutting was originally made, everything was done that was necessary; and as for the puddling of these drains, they might have been puddled for miles in length on each side of the railway, without contributing one single atom of benefit towards the prevention of the slips. Further on, the professor disapproves of what is being done by way of precaution, and recommends that "apertures should be driven in horizontally, and brushwood drains introduced, or a kind of hurdle or *fascines*, which would act as a drain, and be extremely efficacious. I do sincerely hope and trust that the Croydon Railway Company will never act upon this advice, because if these apertures are driven any distance into the hill, they will tap a much larger body of water than that which finds its way at present to the face of the slopes, and as soon as the drains become at all choked up, down comes a slip much more extensive than any that has yet happened; while on the other hand, if the apertures be not driven more than a few feet into the slope they will not catch the water which occasions the mischief, and thus for all the good they will do, might just as well have been driven so many feet into one of the mountains in the moon.

I am, Sir,
Your very obedient servant,
Justus.

REMARKS ON DR. FULTON'S LECTURE.

Sir—Having perused Dr. Fulton's lecture on the "State and Study of Civil Architecture," as inserted in your March number, and considering some of the observations made by him to be incorrect, I venture to offer a few remarks on the same, hoping that if you have any superfluous room, you will favour them with a place in your next number.

And, first, with regard to the origin of pointed architecture, the lecturer asserts that it (together with the Saracenic,) was derived from the Roman, bringing forward as evidence the fact, that at Spalatro are found slender columns supporting circular arches with distorted human faces, introduced as ornaments; but at the same time he admits that the pointed *arch* is not found there. Now I would observe that the pointed arch is the elementary ingredient of the pointed style, and that without its presence a building cannot be regarded as of that style, so that to detect *its* origin is, in fact, to detect the origin of the style to which it belongs: I shall, therefore, endeavour briefly to show that Rome was not the originator of it. It is a well-known fact that the pointed arch made its appearance in the different countries of Europe at very nearly one and the same time, viz. just after the termination of the first Crusade; and this fact manifestly points to some one locality from whence all the nations of Europe among whom it sprung up must have derived the idea of it. Moreover, this must have happened at the same time, for if it had not, or if they had borrowed the one from the other, there would necessarily have been specimens in *our*, or at all events in *some*, of these countries, before the others had time to borrow it.

But if the Europeans all derived the idea of the pointed arch at one particular time, and from one particular place, it follows that *that* place must have been one of general rendezvous; and since the time in which it appeared was just after they had returned from the first Crusade, it is in a high degree probable that they obtained this idea from the East, or else from some of the countries through which they passed on their way thither. Now there are specimens found in the East of the pointed arch of a date anterior to the first Crusade, so that this circumstance appears to give a degree of assurance to the notion that the Europeans derived it from the Saracens; but admitting that they did not, still there is no evidence in favour of their having obtained it from the Romans, for I am not aware that the first Crusaders passed through Italy at all. Moreover, if they had, seeing that there was no actual specimen of the pointed arch to be found in those parts, they must have seen something in Roman architecture which *indirectly* conveyed to them the idea of it; and in this case it is extremely difficult to conceive that they should all happen to hit on the same train of reasoning, and thus, each for themselves, light upon the pointed arch.

In the second place, Dr. Fulton states that the Greeks did not leave even their Doric columns without bases, but that the steps on which they rested formed an ample basement. I grant, indeed, that these steps did form an ample basement to the edifice, considered as a whole, serving both to beautify and strengthen it, but certainly not as a base to each individual column. His reasoning, too, is fallacious, for he says, "What would the finest statue that ever was made appear to be, with its feet sunk in the ground or cut off?" According to this, then, we must admit that the columns represented statues, and the stylobate their feet; and if so, what is the result? Why simply this; that the Ionic columns in the temple of Minerva Polias (for example), which not only individually have bases, but are collectively superimposed upon a stylobate, represent statues having a double set of feet, one over the other, which, to my mind, would be quite as devoid of beauty as statues with no feet at all.

The third and last point to which I shall take occasion to advert is the lecturer's objections against "gable-topped windows and doors," by which I suppose windows and doors crowned with pediments. His words are, "Of all the strange devices of which I have given a list, this is the most strange." And yet I cannot find out that he has assigned any reason why they are strange, unless indeed it is because he is "unable to discover the use of these window tops;" but if people ask the use of many things in architecture, we shall only have to answer, "Its use is to adorn the building;" and so here, the use of these gable tops is to adorn windows and doors, and to show that they do so in many cases, I need only refer to the lower range of windows in the Strand front of Somerset House, and to the one-pair windows of the Reform Club. Besides, if these gable tops be absurd in Palladian architecture, shall we not be obliged to condemn quite as much the beautiful pedimented canopies over the windows and doors of many of our pointed structures, as, for example, York cathedral; and who will say that they do not form an important element of beauty in those edifices?

With the remainder of Dr. Fulton's remarks I cordially assent; and hoping that I have not trespassed too long on your attention or that of your readers,

I beg to subscribe myself, Sir,
Yours respectfully,
G. W. R.

MORE ON FRESCO PAINTING.

While the subject of fresco painting is in every one's mouth, and we have papers on the subject at the Institute, and lectures at the Royal Institution, it may be worth while to consider the best method for commencing operations.

At a late visit to Hampton Court, on entering the staircase to the gallery of the chapel, I was struck with the excellent opportunity there presented for an essay in this new style of art, by which additional interest might be given to a part of the building now but little visited, at a moderate expense, and with great advantage to our artists. The staircase is of oak, of the time of Queen Anne; the plan is a square of about 25 ft., and wainscotted about 8 ft. above the upper landing, leaving on their sides perhaps a dozen feet more of bare plaster up to the cieling, and lighted by windows on the fourth. On these spaces, which are well calculated for this kind of decoration, the artists likely to be engaged with the new Houses of Parliament might be employed to try their hands. The situation is not one of such vast importance as to render the probable slight imperfections of a first attempt very alarming; and by beginning in this moderate way, the danger would be avoided of a failure in a more conspicuous siuation, which might give an excuse to the timorous to call in the aid of the Germans, and for the enemies of innovation to abandon the thing altogether; and we may certainly hope that the earliest efforts of our artists, inexperienced as they are, would be superior to plain whitewash. Neither would they be induced to make their essays in situations where the paintings could not be permanent, and by that means, as far as everything but mere practice was concerned, throw away their time and materials to no purpose.

This locality is only mentioned as a specimen, of which hundreds might be found elsewhere, and many in the same building; all of which, besides perfecting the painters, would tend to make the style more generally known, and thus interest the public in it from its very commencement.

In the progress of this high style of art, much will depend on the architects; for if they oppose it, or do not recommend its introduction in their buildings, it can never be generally adopted.

J. L.

ON INCREASING THE EVAPORATIVE EFFECT OF BOILERS.

Sir—In my communication inserted in the last *Journal*, I assure you I had no desire unnecessarily to occupy your useful columns, by "taking a range of several months," in replying to the very severe remarks of the reviewer of my "projects." I trust, however, to your candour, in affording me an opportunity of setting myself and my "projects" right with your readers, not as to the personal matter, but to the scientific and practical details of the subject. Having disposed of the comments on my suggestions for increasing the evaporative boilers, by means of longitudinal conductor pins, I now come to that of the "smoke preventive plan."

The reviewer observes—"Our philosopher says that combustion" (of the gaseous matter from the coals) "does not take place (in the furnace), inasmuch as he has doors to his ash pit, which he shuts immediately that the furnace has received a fresh charge, and which he keeps shut until the gas is all expelled." To this I have only to say, it is entirely a gratuitous assumption. I am guilty of no such absurdity. That I recommend doors to ash-pits, as others have done before me, is true; not, however, for the sake of *excluding* the air, or producing an "hermetically sealed boiler furnace," but of regulating its *admission*, as far as is practicable, to the ash pit and bars, the doors being furnished with suitable slides or registers; thus, in some measure apportioning the quantity supplied to the demand, and where, in ordinary furnaces, no attempt at any regulating means is made. The reviewer then goes into a lengthened refutation of this manifest absurdity, which happens to be exclusively the work of his own fertile invention; and which I need not further notice.

He then observes—"All smoke-burning projects operate upon the principle of admitting an *excess* of air into the furnace and flue, and this principle is attended with two insuperable objections. First, the refrigeratory effect of the great excess of air which it is necessary to admit to a mixture of the gases, to accomplish the indispensable condition of combustion—proximity of the atoms to be combined; and second, the impracticability of apportioning the admission of air to the ever-changing quantity of smoke evolved." Now here are two important and clearly enunciated terms; and my reply is, that it is expressly to correct these two evils that my plan applies, viz. the preventing this refrigeratory effect, by rendering an "excess" of air unnecessary; and second, the aiding the operations of nature, by removing that very obstruction to the process of diffusing this "excess" of air. And here I would just hint at a chemical error under which the reviewer labours; inasmuch as the "great excess of air" he speaks of, as being necessary to a "mixture of the combustible and incombustible gases, in accomplishing the indispensable condition of combustion—the proximity of the atoms to be combined," is a very serious impediment, rather than a necessary aid, to that very condition. For this well-established chemcial fact, (as my opinions are too "insane" to merit attention,) I beg to direct the reviewer to Davy's "Researches on Flame." And may I not here be allowed to remark, in a spirit of good humour, that if I be that "ponderous gentleman" whose "attendants should insanify with a few grains of common sense," other persons may possibly consider my would-be guide as that imponderous and light-headed reviewer, whom it would be well to ballast with a few grains of chemical knowledge, to qualify him for steering his own bark, before he undertakes to correct the reckonings of others. But, badinage apart, this very "excess of air," which is here laid down as "necessary," is as great an enemy to proper diffusion and perfect combustion, as a deficiency would be; but on this, it is unnecessary here to dwell. To correct this impracticability of apportioning the admission of air to the "ever-changing quantity of smoke evolved from an ordinary furnace," I separate the air into two supplies, thus rendering them more manageable, and, what is more important, less liable to interfere with and mar each other's objects; a system, also, which has this practical value—the causing them to be, to a great extent, mutual correctors of each other's defects. The one supply is sent to the ash pit and bars, for the combustion of the solid carbonaceous portion of the fuel; the other to the gaseous matter evolved from it.

But I ask, why shall this want of a more correct means of regulating the supply of air to the demand, be so peculiarly chargeable on my mode of admission; while the ordinary plan of furnaces is so lamentably and wholly deficient on this head—nay, even absolutely prohibitive of any attempt at regulation? My mode, to a great extent, practically corrects the evil (as I am now showing in my papers on this subject in the Mechanic's Magazine), while, by the ordinary method, the supply of air is most restricted by the body of fresh fuel on the bars, at the very time when an increased quantity is most required, by reason of the increased quantity of gas evolved. The absence, then, of the means for "adjusting the quantity of influent air to the variable condition of the fire," bears with infinitely greater force against the old plan, so pertinaciously adhered to, and which rejects any effort towards adjustment. Again; although this variable supply of air required has reference to the gaseous matter evolved above the fuel, rather than to the solid matter on the bars, yet these sticklers for a regulating valve would absolutely compel the supply of air which is intended for such gaseous matter to pass through such bars and body of incandescent fuel, where it necessarily loses much of its oxygen, if not the whole; thus virtually sending the smallest quantity of oxygen to the gases when they were most redundant. Let those, then, who cavil for a regulating valve, first apply the argument to their own old favourite system before they object to mine, which practically and to a great extent meets the difficulty.

The reviewer next observes—"But the parturient mountain has again brought forth a mouse. This learned philosopher, after vapouring about atoms and gases, presents us with—what? a veritable antique smoke-burning furnace." If this be true, then we must be prepared to call the Argand burner a veritable smoke-burning lamp. This sneer at "vapouring about atoms and gases" I must say is, at least, inappropriate from that pen which had just before truly and scientifically urged the "indispensable condition of combustion—the proximity of the atoms to be combined"—the very point on which the whole atomic theory, as regards the union of gases, rests its value. Again; I am told "the sole peculiarity" of my plan is that "the air enters by a greater number of holes than usual." Will the reviewer inform your readers whether this peculiarity be not the very one which characterizes the Argand burner? Again; "whether, of two smoke-burning projects, the least objectionable is that which admits the air at one hole, or that which admits the air at many holes, it would here be irrelevant to inquire." Now, Sir, that is the real point worth inquiring into; and this blinking the main question at issue will not go down with your scientific readers, unless he can first persuade them that there is no difference between the brilliant smokeless burners in our shops in Regent-street, and those flaring smoking flames which the butchers' stalls exhibit; the sole difference being that which is here said to be irrelevant—namely, the difference between the one large hole and the many small holes. For, chemically, the effect is the same, whether the air be admitted in jets to the gas, or the gas in jets to the air—my mode of admission being, in the words of Professor Brande, "an experiment upon the large and practical scale which I have often made on a small and theoretical scale, in illustration of the inaccuracy of the common terms 'combustible,' and 'supporter of combustion,' as ordinarily applied."

"We are informed," says the reviewer, "that Mr. Bourne has a patent for the same thing of the date 1838." I beg to say the reviewer is misinformed. Mr. Bourne's patent is for the generation of gas from retorts placed in a furnace over the incandescent fuel on the bars, and, when the gases are expelled from these retorts, drawing the solid coke from them on to the bars below, to keep up the body of incandescent matter. It must, therefore, be to this invention that Dr. Lardner and Mr. Farey's reports apply. But it matters not; for if this identical "same thing" be so good under Mr. Bourne's name, it cannot be so very insane under mine. On the merits of the actual invention of Mr. Bourne, I forbear to speak; of the actual plan of a furnace which he afterwards adopted in the steamers on the Thames, after having rejected his own, I have already said enough in my treatise, where I have given it in proof of one of the erroneous modes of effecting the combustion of the gaseous products of coal: neither will I say anything of Mr. Bourne's anonymous essay, now before me, out of respect to Mr. Bourne himself.

But perhaps the gravamen of the charges against my presumption in questioning the practice of our "operative engineers," may be discovered by the concluding observation, that "engineers and boiler-makers know their business much too well to lack information from a pack of effervescent chemists and druggists"—meaning the first chemical authorities of the day, Professor Brande, Dr. Ure, Dr. Kane, Professor Daniell, &c. I beg leave to assure the reviewer that many of the first engineers and boiler-makers have, in a manner worthy this inquiring age, expressed themselves in a very different manner, urging me to pursue the inquiry, and follow up those experiments on the large scale which have so opened their eyes to the defective system and empirical rules, on which they have hitherto relied.

I am, Sir,
Yours, &c.
C. W. Williams.

Liverpool, March 15.

MR. WILLIAMS' BOILER PROJECTS.

Sir—The appearance in your Journal for February of a paper purporting to be an analysis of Mr. Williams' boiler projects, seems to call for some explanation on the part of those whose investigations on the subject may have lead them to other conclusions than those arrived at by the ingenious author of that essay. Just adverting to the critical acumen displayed in deriving the authorship of a communication to the London Mechanics' Magazine, to which the author's name happens to be prefixed, or the peculiar character of the internal evidence which led the learned analyst to the unexpected conclusion that Mr. W. was the writer of the paper which Mr. W. read before the Polytechnic Society, I may perhaps be permitted to make one or two observations before proceeding to reply to the details of the critique.

That the first of a series of papers devoted to the development of a department of physical science, hitherto almost untrodden or giving only the most discordant results, and uniting the deepest interest with the greatest abstruseness, should be selected as a peg whereto to append a string of most ludicrous corollaries, evidences the existence of a spirit of such jocose and sprightly philosophy, that one is a little at a loss in what strain to reply. Perhaps the best answer would be, affectionately to admonish the writer to read a little farther, and acquire a little more thorough acquaintance with the subject than the perusal of a prefatory chapter can convey. At the same time, I am well aware that to criticise a subject it is not necessary to be intimately acquainted with it—nay, the very negation of acquaintance will sometimes be found marvellously to facilitate the operation, and the more skilful the reviewer, the less need will there be for the preliminary drudgery of first studying the subject, so that a very able writer indeed will have no difficulty in writing a very good article on a subject he knows nothing about at all.

To enter minutely into the possible modes of action of the conduction pins, whether as facilitating combustion by assisting the interchange of electricities essential to chemical action, or as aiding the generation of steam, on the same principle that internal asperities in an evaporating vessel facilitate the process of vaporization, would be to write a treatise instead of (which is our present object) to reply to an objection. Let us, then, for the present, confine our attention to the conducting power alone of the pins whose action has been attended by such striking effects.

We know, by the experiments of M. Delarive, that the conducting power of some substances of a fibrous texture, such as wood, varies exceedingly according as conduction takes place in a direction transverse or parallel to the fibres. We are thus prepared to expect similar results in the case of those metallic bodies in which the fibrous arrangement is strongly marked. It is true we do not possess accounts of experiments made to determine the relative amount of lateral and longitudinal conducting power in such bodies; but there are phenomena connected with the transmission of heat through solid bodies, which would lead to the conclusion that it follows different laws in different though similar substances, and that general theories, founded on the supposition of uniformity of action among the consecutive elements of different bodies are not to be depended upon.

For instance, it has been found that in some cases, increasing the dimensions of the conducting substance in the direction of the conduction, produces very slight retardation in the passage of the heat, a fact sufficient to destroy all confidence in reasonings founded upon the ordinary hypothesis of a rapidity of transmission proportional to the difference of temperature of the contiguous elementary laminæ of which we may conceive the body to be composed. We are thus prepared—I do not say to adopt the conclusion—but to listen to the arguments which may lead to the conclusion, that the power of transmitting heat depends on something more than mere inequality of temperature in the consecutive elements. In the case of an ordinary steam boiler, we do not know the temperature of either the interior or exterior surface of the plates; all we know is, that the one cannot be hotter than the flame, nor the other colder than the water contained, but between these limits we know nothing; and we are still further removed from a knowledge of the laws which regulate the communication of the heat, and the approximative equalisation of the temperature.

With these observations let us now consider the action of the pins, on the supposition (certainly not a correct one) that the stratum of air in contact with the boiler surface and the whole length of the pins, is of uniform temperature. We in this case naturally expect that the lower extremities of the fessing considerable economy of fuel, should make the removal of these pins will attain a higher temperature than the exterior surface of the boiler, and we may conceive that that section of the pins which lies in the plane of the outer surface of the boiler, may differ more or less in temperature from that of the outer surface itself; but the rapidity of the transmission of heat may proceed according to very different laws, and the greater difference of temperature between the extremities of the pins, combined with the greater facility afforded by increase of surface, for the reception and giving out of heat, may occasion such an increased intensity of transmissive action as to cause a greatly increased flow of heat into the boiler, and that the evaporative power is increased in a much higher ratio than the consideration of the actual increase of heating surface would lead us to expect, appears from experiments that have been made on a large scale. So great, in fact, has been this disproportion, that we are compelled to investigate the action of the conduction pins, on another and more likely supposition, which, however, is so much in accordance with the laws of nature, that it ought rather to be adduced as an explanation than adopted as an hypothesis. Instead, therefore, of considering the boiler surface and the whole length of the pins to be enveloped in an atmosphere of uniform temperature—which is almost an extravagant supposition—we shall take into account the cooling agency of the boiler surface on the stratum of air in contact with it. Now at the high temperature of common furnaces, from 1000° to 2000° F., a given depression of temperature will occasion a diminution of volume of only *from* $\frac{1}{3}$ to $\frac{1}{5}$ of what would take place at ordinary temperatures, and a correspondingly diminished ascensional force in the lower contiguous stratum. But this ascending stratum will be cooled to a certain extent by crossing the other, and the resulting temperature of the succeeding film that comes in contact with the boiler will be lower than that of the stratum removed a little farther from the cooling surface. Thus a refrigerating action is carried on, and the longer the operation continues, the greater will be the uniformity of the temperature attained throughout the mass. But when we consider the rapidity of the current through the flues, ascertained by Dr. Ure to be not less than 36 ft. per second, we are lead to the conclusion, that the process of refrigeration cannot have penetrated to a great depth before the heat-giving atmosphere has quitted the flues entirely, and that the lower extremities of the pins must be enveloped in an atmosphere of higher temperature than that from which the bottom of the boiler derives its heat; while in the anterior part of the boiler, this will be still more marked, almost the whole projecting length of the pins being exposed to a rapid current at a very high temperature, while the partially refrigerated gases will glide along the surface of the plates.

When we consider the temperature of the air in the smoke-box of a locomotive in full action, known to equal that of red hot iron, after submitting to the operation of a refrigerating mechanism so much more complete than that to which the products of an ordinary furnace are subjected, we can no longer view with incredulity, or even with surprise, the results of the experimental investigation that demonstrates the efficacy of the conduction pins.

We have hitherto confined our attention to the action of the pins in a horizontal or nearly horizontal surface; in the case of an inclined or vertical surface, the preceding train of argument is still more applicable. In this case the descending current of air, instead of tending to quit the surface to which it has given out its heat, will glide down the sides still preserving its contact, and giving out a diminished quantity of heat as it descends, while the outer extremities of the pins will be exposed to the action, at a high temperature, of a rapid current that would otherwise have been hurried along to the chimney, without giving out any heat to the boiler at all.

With regard to what has been denominated the second part of Mr. Williams' boiler projects, perhaps I might presume to tender similar advice to that which I gave before entering on the discussion of the conduction pins—not so much that the critic should peruse Mr. Williams' treatise on combustion, but that he should study the instructive and beautiful commentary on that work which the operation of the argand furnace presents, a commentary which possesses the advantage of being proof against misinterpretation, being an infallible mean of convincing those who are less accustomed to be guided by the deductions of their understanding than the impressions of their senses. As the gist of the argument of the reviewer of the "Projects" hinges on the definition of smoke given in a pamphlet entitled "Thoughts on Steam Locomotion," I may be permitted to transcribe a few sentences: "The great waste resulting from smoke, the product of imperfect combustion, which must be estimated not merely in the proportion of the unconsumed carbon, but also in regard to the heat which becomes latent in its formation, and is dissipated in the atmosphere, and the many inconveniences consequent on its formation—are such as to render it expedient that all schemes pro-defects their starting point. Smoke may therefore be regarded as a mixture of combustible and incombustible gases, in such proportions as to prevent the combustion of the mixture with practical economy."

Smoke is here defined to be the product of imperfect combustion; but what are we to understand by the term "imperfect combustion;" there is no such thing in nature. Who ever heard of imperfectly formed carbonic acid, or of steam without a saturating equivalent of oxygen. In fact, the term "imperfect combustion" refers to a period in the history of science when the doctrine of chemical equivalents and the atomic constitution of bodies was still undeveloped, and though justified by common usage, yet language so unprecise is unsuited to philosophical definition, where precision is the great requisite.

The product of imperfect combustion must, therefore, be understood to mean, the products of perfect combustion, mixed up with what is not the product of combustion at all, or, in other words, a mixture of combustible and incombustible gases; but how this should ever come to be regarded as a definition of smoke—nay, as being *par excellence*, "the very definition" by which must be tested the merits of all smoke-burning and smoke-preventing schemes whatever, is likely to remain a mystery till it please the author of "Thoughts on Steam Locomotion," to elucidate the subject in a second edition.

That a mixture of carbonic acid gas and olefiant gas, or of coal gas with nitrogen should produce smoke, even though "when taken they be well shaken," is a discovery, which I apprehend may look for its establishment to a period in the prospective history of science, nearly as remote as that to which we are referred in the retrospective, by the term imperfect combustion. And such it seems are the opinions on the constitution of smoke, to which it is alleged Mr. Williams was indebted for the views he has developed in his treatise on the combustion of coal. Let us now attend to the process of its formation, as explained in that treatise. We shall find it to be carbon precipitated from the state of gaseous combination or solution in which it had been held by hydrogen or other gases, forming, it may be, cyanogen or carbonic oxide, but principally the ordinary hydrocarbons. The decomposition of either of the former, or the partial combustion of the latter, may occasion smoke.

We shall, for the present, confine our attention to the hydrocarbons; and in the first place, smoke may be produced, if to the gas at a high temperature be presented a certain quantity of oxygen, but not sufficient to saturate both the elements composing the hydrocarbon. In this case the hydrogen, in virtue of its superior affinity, will combine with its equivalent of oxygen while the carbon will be precipitated, and when cooled below the temperature of ignition, will assume the form of smoke. Secondly, the reduction of the temperature below that which is required for chemical action, after combustion has commenced, is the other principal cause of the formation of smoke. In this case the decomposition of the hydrocarbon will go on, if there be any uncombined oxygen present, steam will be formed, while the carbon being cooled down below the temperature required for combustion, will speedily assume the form of smoke.

The cooling effect of a body of cold air suddenly admitted into a furnace, must be familiar to all who have studied the phenomena of combustion; smoke is produced immediately in consequence of the condensation and deposition of the aërial carbon previously held in solution by the hydrogen.

Let us now consider the arguments by which it is intended to be proved that Mr. Williams' furnace is in reality a smoke-burning and not a smoke-preventing. The substance of the argument is this; in Mr. Williams' furnace carbonic acid is first of all formed, and comes over mingled with the carburetted hydrogen produced by the destructive distillation of the coal. Here, then, is the product of imperfect combustion, a true mixture of combustible and incombustible gases, but this is smoke according to the very definition. When, therefore, we effect the combustion of the hydrocarbon in this impure state (or rather in this disreputable company), it seems that we do not burn gas but smoke. In short, the unlucky hydrocarbon is disfranchised at least, if not decomposed, by its unfortunate proximity to the product of combustion, with which it is more or less contaminated, becomes no longer entitled to the privilege of a combustible gas, but must prolong or terminate its existence as it may, under the ignominious character of smoke. A moment's attention to the actual constitution of smoke as explained above, is sufficient to show the absolute fallacy of the above conclusion. And when we consider that neither of the circumstances which concur in the formation of smoke have place in the argand furnace, viz. either deficiency of oxygen or an injurious reduction of temperature, we shall have no hesitation in according to Mr. Williams the merit of having produced a smoke-preventing furnace.

To enter further into an elucidation of the principles on which is founded the peculiarly happy and successful practice of Mr. Williams, would at this time of day be quite superfluous; the public are already in possession of full information upon the subject, and anything that could be stated here would be only a repetition of what has been better said elsewhere.

Sir, I am,
Your's, &c.
A. S.

"MR. CHARLES WYE WILLIAMS, AND HIS BOILER PROJECTS."

Mr. Editor—The perusal of the article under this head in your last number, has induced me to trouble you with a few remarks upon the subject of combustion.

It has frequently been a matter of surprise to me, that so much has been written upon this important subject, with so little practical result. It is true we continually hear of experiments, by which some new smoke-consuming theory has been established beyond all question; but unfortunately, no sooner is this new light brought to the test of every-day experience in the stoke-hole, but it is found that, for want of the required degree of combination of either the oxygen, hydrogen, nitrogen, or carbon, that bi-carburetted hydrogen is generated, and from the absence of sufficient radiation of heat from the brick-work of the furnace, this dense olefiant gas is not decomposed, ergo is not consumed, and consequently it escapes up the chimney, to publish to the world the failure of the experiment. It is vain to attempt any explanation of the cause which has produced this effect, to the astonished stoker; all you get from him is a look expressive of unutterable things.

I can speak feelingly upon this subject, having some little time since had an excellent opportunity of testing the practical value of some of the most plausible propositions for economising fuel. About three years since, I was engaged by a Patent Salt Company to give designs for, and to superintend the construction of several of their furnaces, with a view to greater economy in the fuel department, the vital importance of which will be better understood, when I inform you that their annual consumption of coals averages 25,000 tons. It will not be necessary to go into a detailed account of the effect of my alterations of the furnaces in question, but simply to confine the following remarks to the general result of the various experiments. I was naturally anxious to avail myself of the assistance of every modern panacea, which had a sufficient degree of plausibility attached to it; and consequently jets of steam discharged upon the burning fuel; cold air admitted in various quantities, in different directions, through apertures of all sorts and figures; single fire doors, double fire doors, and no fire doors at all; register doors to the ash pit; bridges of divers heights and arrangement; throats of all capacities; dampers in various positions, &c. (but I did not *spike* my boilers,) were severally and fairly tried under my own superintendence, for months; and the result of all these experiments was my settled conviction, that however well adapted these modes of combining some gases and decomposing others may be to the lecture-room or laboratory, that in every-day practice they are to a great extent useless, and that the chief desideratum has been lost sight of. This I take to be a regular and constant supply of fuel, thinly scattered over the surface of the fire; without the necessity of the frequent opening of the fire door.

Several attempts have been made to effect this desirable object, but none that I know of are as efficient as I think they may be made. I am at present too much engaged in another department to devote my time to this subject, but I think it would repay some of your readers to do so.

I am, Sir,
Yours obediently,
E. Leader Williams.

St. John's, Worcester,
Feb. 9, 1842.

[The observations we purpose to offer in answer to the preceding communications we shall reserve for our next number. A portion of the letter of Mr. E. Leader Williams, as being irrelevant, we have omitted. We have also been obliged to omit a communication from Mr. Smith of Manchester, in support of Mr. Williams' views, but as the points urged by Mr. Smith are still more fully developed in the communication of A.S., Mr. Williams' cause can suffer nothing from this omission. As journalists we may sometimes be compelled to be severe, but we trust to be always impartial.—Editor.]

ON THE GORGON ENGINE.

Sir—I had expected to find in your February number some answer to the observations of "Vulcan" inserted in the preceding one; but, as none has appeared, I am induced to trouble you with a few remarks, in reference to the misrepresentations and fallacies contained in the letter alluded to.

The writer professes to found his criticisms upon statements contained, as he pretends, in a certain "pamphlet published by Messrs. Seaward and Co." Had this pamphlet been really published and publicly circulated, it would only have been necessary to refer your readers to it, in order to enable them, if they exercised common candour and common sense, to detect at once the errors (to use the mildest form of expression,) which "Vulcan" has thought proper to propagate; but unfortunately this pamphlet was printed only for private circulation, and I do not think a copy of it can be found at the British Museum or in any of the public collections, except that of the Institute of Civil Engineers.[*] "Vulcan" appears to have taken advantage of this circumstance to circulate and to attribute to the authors of the pamphlet statements which he must know, if he has read the work at all, it does not contain; and it is principally on this account that some exposé of his misrepresentations becomes the more necessary. I will endeavour to supply this, taking his different statements *seriatim* for the purpose.

He first attempts to show that no merit is due to Messrs. Seaward for the introduction of the engine of the description erected in the Gorgon; and in order to give colour to the detraction, it is pretended that the manufacturers have laid claim to the *direct application of the power* as a *new arrangement* of their own. This is, indeed, not expressly stated, but it is obviously meant to be inferred, or why enumerate engines "identical with the Gorgon *so far as the direct application of the power goes?*" On referring, however, to the pamphlet itself, we find the following passages—"These engines are constructed on the principle of *what is called* the direct action;" and again, "It should be observed, that many engines have been constructed, previous to the Gorgon engines, upon the principle of the direct action, but the arrangements of all those engines have been widely different." These expressly repudiate the claim to the introduction of the "direct action," *per se*, as an invention of the manufacturers; but it is well known that the arrangements of the minutiæ of an invention often contribute as much towards its success as the principle on which it is founded; Messrs. Seaward, therefore, may be very well content to confine their claim to the merit of having, by new *arrangements*, rendered a *principle* efficient and applicable, which was never before so complete on a large scale.

For, what are the facts? Marine engines have undoubtedly been constructed with direct action, prior to the date of the Gorgon's, but with what success? The "Tourist" engines (with the arrangements of the *fixed* cylinders, "*very like*" Mr. Penn's *oscillating* ones,) never worked well, were removed from the vessel upwards of seven years ago, and common beam engines substituted; while those of the "United Kingdom," notwithstanding their "considerable improvements," and the assurance the writer feels of their "advantage over the Gorgon's," were, according to the best information I can obtain, in actual work only about four years, and are now taken out, the "splendid ship" itself being converted into a coal depôt. At the time of the erection of the Gorgon engine there were no direct action engines of any importance in use: all the makers were constructing them upon the beam principle: but since that event what has been the result? I am informed that Messrs. Seaward alone have fitted eleven large vessels with these libelled engines, amounting together to about 3000 horses power, with the most perfect success; and many other firms, among whom may be mentioned Maudslays and Field, Boulton and Watt,[†] Miller and Ravenhill, Robert Napier, and Fairbairn & Co., are at the present time constructing engines with direct action. All, therefore, that "Vulcan's" instances prove, is, that Messrs. Seaward are the first who have succeeded in doing what Messrs. Gutzmer, Napier, and all who went before them, were unable to accomplish, namely, to make the direct action principle successful in practice, and to show that it is capable of realizing the advantages which have indeed heretofore been sought from it, but sought in vain.

Before noticing the remarks upon the *intrinsic* merits of the Gorgon engine, I will take the liberty of quoting the passage from Mr. Seaward's pamphlet, in which the advantages are enumerated that this form has, as it is considered, over the beam engine. It runs as follows:—

"The advantages of the present system are very considerable, and consist of:—

"1st. *A great saving of space.*—A pair of Gorgon engines do not occupy much more than one-half the space required for a pair of beam engines of the usual construction.

"2nd. *A great saving of weight.*—The weight of a pair of Gorgon engines is 25 per cent. less than that of a pair of beam engines.

"3rd. *Greater exemption from accident.*—The simplicity of the arrangements, and the reduced number of moving parts, necessarily lessen the chance of accident, as also the wear and tear.

"4th. *Greater security for the engine-men who work the engine.*—There being no side levers or beams in movement, the men can move round the engines in every part with perfect safety; but they cannot do so with beam-engines, without much danger.

"5th. *The tremor and vibration usually experienced in steam vessels are almost entirely prevented.*—The chief cause of the tremor and vibration observable in steam vessels, is the pumping action of the beams or side levers, which causes a great strain and effort throughout the whole vessel; but there is nothing of this in the Gorgon engines.

"6th. *A more efficient and economical application of the motive power,*—resulting from the absence of a large mass of moving matter, and of many joints and bearings, the latter of which especially, is in ordinary engines the cause of *much* loss of power."

I will leave your readers to compare this with "Vulcan's" paragraph, beginning "In a pamphlet," &c., and they will see how the writer has adhered to the text in his pretended quotations. It will be desirable to correct such of his statements as may have a tendency to mislead those who have not an opportunity of inquiring for themselves.

First, then, "Vulcan" denies that the Gorgon engines take up *less space* than the common ones, and has given your engraver the trouble of copying a "*sketch*" of the framing of some hypothetical and imaginary beam engine of his own, under the drawing of the Gorgon, for the purpose of substantiating his charge. I cannot deny to "Vulcan" the right of "*sketching*" beam engines in any manner and with any proportions or "architecture" he may think fit; but I will beg such of your readers as may take an interest in such matters to refer for comparison, *not* to "Vulcan's" "*sketch,*" but to authenticated drawings of beam engines in actual existence, or to the engines themselves.

The following table exhibits a comparison of the length occupied by three of the engines upon the direct principle, with three others upon the old construction, the saving in *length* being in that part of the ship which is most valuable for stowage of cargo.

Name of Vessel.	Description of Engine.	Makers of Engines.	Horse Power.	Length of Engine room.
Gorgon	direct	Seaward	320	62
Driver	"	"	280	52
Hydra	beam	Boulton & Watt	220	62
Medea	"	Maudslays & Field	220	60
Vivid	"	Seaward	220	58
Devastation	direct	Maudslays & Field	400	54

The saving in *width* is so self-evident as scarcely to need remark, from the entire absence of all machinery outside the cylinder. It is this saving which enables vessels fitted with direct action engines to stow such large quantities of fuel on each side of the engine room.

Then as to the saving in *weight*, we have "Vulcan's" dictum that 0·93 tons per horse power is an "ample allowance for beam engines of the size of the Gorgon." This is very easy to assert, but not quite so easy to prove; I would ask him to particularize some engines which are of this weight, giving the makers' names, *the diameter of the cylinders*, &c., by which we may see that the comparison is fair, and that the horse power is calculated by the same rule as the Gorgon's. It is strongly to be suspected that "Vulcan" must make use of a higher estimate of the mean pressure upon the piston than the Thames engineers, as the Scotch frequently do in calculating the power of their engines; and if this be so, it is easy to perceive that he may call a certain engine 350 horse power, which in our nomenclature would be only 300, and his 0·93 ton per horse power would then amount pretty nearly to what is known to be the actual weight of beam engines afloat, namely, about 1 ton.

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[*] Nearly the whole of the pamphlet was published in the *Journal* for Nov. 1840, p. 375, Vol. III, and for Feb. 1841, p. 59, Vol. IV.—Editor.

[†] See engraving of the Virago engines in the February No. of the *Journal*

As a proof that this weight is not over-rated, I cannot do better than again tabulate some known engines of the best makers, giving their weights as compared with the Gorgon.

Name of Vessel.	Makers of Engines.	Horse Power.	Total Weight.	Tons per Horse Power.
			Tons.	
Gorgon	Seaward	320	280	0·88
Hecla	Scott & Sinclair	280	340	1·22
Stromboli	R. Napier & Co.	280	340	1·22
Monarch	Boulton & Watt	220	270	1·24
Medea	Maudslay	220	240	1·1

These weights include water in the boilers, spare gear, and coal boxes complete.

A word perhaps may be added upon another of Vulcan's "astounding facts," which he parades with much pomp and circumstance, namely, the incorrectness of the weight given by Messrs. Seaward to the Admiralty.* The estimated weight of the Gorgon engine (for the *engine itself* is all we have at present to do with, no alteration being proposed in the other portions of the whole weight,) was 121 tons: the *actual* weight, when manufactured, was found to be, adopting "Vulcan's" own statement, 123 tons, 3 cwt.! That is, the *actual* weight was 2 tons, 3 cwt. greater than the estimate; an estimate, be it remembered, formed entirely by calculation, before a single part of the engine was put in hand, and while no other engine of the kind was in existence from which to obtain data. And this is the flagrant error, or something worse, with which Messrs. Seaward are charged, from which "your readers are desired to form their own conclusions," &c., and which "calls so loudly for explanation!"

The following facts, with which I have been furnished by a friend on whom I can rely, are I think, pretty conclusive as to the saving both of weight and space.

The Gorgon steam frigate of 1050 tons was built in 1837, and was originally intended to receive beam engines of 220 horse power, the bulk heads being placed 62 feet apart, the ordinary distance allowed for engines of that size. The estimated weight of these engines was given as 270 tons, including the coal boxes and the water in the boilers; and space was proposed to be allotted for 300 tons of coal.

This same vessel is now, without any alteration of her engine-room, fitted with engines upon the direct action principle, of 320 horse power, weighing less than 300 tons, and has provision for 420 tons of coal in store. Why the change was made, I do not know; but I believe the beam engines originally intended for the Gorgon are now in the Hydra, a smaller vessel but an excellent sailer.

Again, I may instance two vessels in the navy, now afloat. The Stromboli, with *beam* engines of 280 horse power, has an engine-room of 58 feet in length, and carries only seven days' supply of fuel in the engine-room, drawing, with her stores on board, 14 feet of water. The Driver, a sister vessel, built from the same lines, has *direct* engines, also of 280 horse power, in an engine-room of only 52 feet long, in which she carries 14 days' fuel, and the same quantity of stores, at the same draught of water.

The second division of your correspondent's critique is upon the *friction* of the engine. Your readers will observe, however, that there is no mention of any material advantage from lessened friction, in the quotation I have introduced from the Gorgon pamphlet, and I can add that *no such pretension* is made throughout the whole of the work; the object for which this subject is introduced there, being only to defend the engine from the charges brought against it by those who asserted that the loss by friction was *materially increased* by the use of the shortened connecting rod. "Vulcan" might, therefore, have spared himself pen and ink on this head, and had he contented himself with merely insisting that no very material gain arose from this cause, his remarks might have passed unnoticed; but he has not been satisfied with simply chasing away the phantom he himself had conjured up; he has gone further, and, presuming I suppose upon his newly-acquired valour, he has levelled a heavy charge against the Gorgon engine, viz. that "the enormous friction caused by the short connecting rod is so great as to equal ⅓ of the power of the engine passing through them." This renders a few words to him necessary.

He has thought proper to pay us, the readers of your valuable periodical, a very bad compliment, by telling us that we cannot understand an investigation of the subject, wherefore he "avoids all scientific observation as to the laws of friction," &c.; but I am sure that you, Mr. Editor, will join with me in removing the screen behind which he would thus shield himself from the liability of being called upon to prove his daring assertions. He must, or ought to know, that the majority of your readers are not "casual" but "professional" readers, who are perhaps as well skilled in investigation as "Vulcan" himself, and who are not accustomed to take statements for granted, because the person making them "fears his inability to make himself fully understood by casual readers." The case is simply stated; we have the force transferred from the piston rod to the crank pin by two different arrangements of machinery, the transfer in each case being attended with some loss, from the friction caused by the strain or pressure upon the gudgeons. The question is, then, what proportion does this loss bear, *ceteris paribus*, in the case of the Gorgon to that in the other or beam engine? This is perfectly ascertainable by mathematical analysis, and, in fact, in no other way, from the all but impossibility of having in practice *other things alike* in the two cases, which they must be, or extraneous causes will so affect the results as to render them perfectly inconclusive for the object in question. I will, therefore, with your permission, Mr. Editor, call upon "Vulcan" to show what ground he has for his assertion, by giving an investigation of this friction case; or if his "inability to make himself understood" arises from his ignorance of mathematics, he must get those by whom "he was assured" of the truth of his fact to help him out of his difficulty. If "Vulcan" does *not* furnish you with this statement, I will.

The third matter animadverted upon by "Vulcan" is what he calls Messrs. Seaward's *statement*, "that the consumption of fuel does not exceed 6½ lb. per nominal horse power per hour." Now this *statement* is an entire and gratuitous fabrication. "Vulcan" must surely have been thinking of his ancient occupation in "Etna's fiery glow," and must have *forged* it for the occasion; for there is not a syllable about the Gorgon's consumption of fuel in the whole pamphlet, nor is the subject even alluded to throughout the work, except in one passage, page 24, where the saving of fuel is mentioned as one of the "great and paramount objects to be aimed at in the construction of steam engines for navigation." It is, indeed, added that "this system of engines is far superior in all the qualities above enumerated," but the saving of fuel named in the first paragraph seems to have been included in the other more by accident than design, for it is not even hinted at in any other portion of the work. Indeed, to have claimed for the *direct system* any material advantage over the common one on this score, would have been a downright absurdity; for what connection can a different arrangement of the rods and levers have with the consumption of fuel, except as regards the insignificant amount in which the difference of friction would affect it? and who, in their senses, would pretend that such was the fact? That the Gorgon engines *do* work with a much smaller proportionate consumption of fuel than many others, I can very readily believe; but whatever gain there is in this respect must be, of course, owing to improvements in the construction, which are independent of the *direct action* principle, and which Messrs. Seaward could just as well apply to beam engines as to the Gorgon's.

The introduction of the *fuel* question is, therefore, irrelevant, and only shows that "Vulcan" either can never have seen the pamphlet he pretends to review, or must be fixed in a much more discreditable alternative, which your readers will easily supply.

The remainder of "Vulcan's" paper consists of a series of statements which only show the limited information he had obtained upon the subjects he professed to treat of, and which will be sufficiently answered by noting down the following facts.

The speed of the Gorgon's engines, with 420 tons of coal on board and provisions for six months, is 19 strokes per minute; with 200 tons of coal, 21 strokes.

When the "Styx" was tried in the river, "with my lords and a large party on board," she had 260 *tons of coal* in the boxes, and 30 tons of water in the tanks, and the speed of her engines was 20 strokes per minute. "Vulcan" should, therefore, have placed less "confidence" in the information which led him to assert that she had only "coal enough for the trip, and no stores, and made 17 strokes per minute."*

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* As a proof that errors in computing the weights of engines may easily arise, I can state that four pairs of beam engines, of 280 horse power each, were made in Scotland within the last three years, for the Government; each pair weighed about 60 tons more than the weight given by the makers to the Admiralty.

It happens also, unfortunately for "Vulcan's" veracity, that the engines on the Gorgon principle *have* an arrangement to equalize their action, and balance the effect of the weight of the piston and its appendages; and that this moreover is not done by the means of weights upon the paddle wheels.

Those parts of the letter which treat of the "miserable inefficiency" of the "Government folks," who are stated to be so "far behind private knowledge and enterprise," and much of the same description, are worthy of a virulent scribe in an opposition newspaper: but as I should be very sorry to see your magazine made an arena for political discussion, "Vulcan" is very welcome, for me, to continue his tirade against the Government at his pleasure. He cannot deny that the Admiralty have given a decided preference to the direct form of engine, or he would doubtless be glad enough to do so; if he chooses to go upon another tack, and ascribe this line of conduct to their ignorance or their unjust partiality, it is of course with "my lords" that he has cause of quarrel, and not with the Gorgon engine.†

The "prophecy" with which the paper concludes will be upon record, and to it "Vulcan" may refer, in proof of his own sagacity and foresight, when he finds the Gorgon engines removed for inefficiency; but at present, while some of the vessels thus fitted are amongst the fastest sailers of their class, and while their superior adaptation for war purposes is proved by their services in actual engagement, (to which "Vulcan" bears such reluctant testimony,) we may safely conclude that the day of "Vulcan's" glorification as a true prophet will be yet far, far distant.

I am, Sir,
Yours obediently,
WILLIAM POLE.

Bloomsbury,
Feb., 1842.

MR. JOSIAH PARKES AND THE COUNT DE PAMBOUR.

SIR—In a letter inserted in your number for last October, Mr. Josiah Parkes has brought forward two grave charges against M. de Pambour: first, of "gross and lamentable ignorance of practical matters," founded upon a passage from this author's "New Theory of the Steam Engine;" secondly, of having misrepresented and falsified certain of Mr. Parkes's opinions and writings. The latter of these charges the Count has already sufficiently defended himself from, but the former he has left unnoticed, doubtless under the supposition that its groundlessness and absurdity must be so self-evident, as to render a formal refutation unnecessary. This may perhaps be the case, as far as those are concerned who are well acquainted with the subject on which the charge is founded; but it is probable there are many who, for want of information, may be inclined to construe the silence of Count de Pambour into an inability to deny the truth of the allegation, and I think it but common fairness that such should be shown the true state of the case. I should blush for English engineers, if there could not be found among us some liberal enough to defend from such ungenerous attacks as these, a distinguished foreigner who has, on connecting himself more immediately with our country, laudably devoted his time and talents to the advancement of our scientific knowledge.

M. de Pambour's passage is as follows:—"Under this circumstance (the use of the *cataract*,) the engine does not evaporate the full quantity of water that its boiler would otherwise be capable of evaporating per minute." Mr. Parkes cites this to show the "gross ignorance" it displays, adding that "neither the Cornish, nor any other engineers ever, probably, imagined the cataract to exercise an influence over the *production of steam* in the boilers of their engines.

Now the following facts cannot, I am sure, be denied by any one at all acquainted with the working of Cornish engines.

1st. The use of the *cataract* determines the number of strokes to be made by the engine in any given time.

2nd. No steam being ever allowed, in Cornwall, to blow away at the safety valve, the quantity *produced* is necessarily only what is *used*.

3rd. The quantity used depends *(ceteris paribus,)* upon the number of strokes made by the engine in a given time.

4th. From which it must follow, if there be any meaning in words, that "the use of the cataract" *does* "exercise an influence over" the quantity of steam used, and consequently over "the production of steam in the boilers."

And of course when the cataract is so arranged as to cause the engine to make *less* than its maximum number of strokes per minute, (which is generally the actual state of things,) it must be evident that "under this circumstance the engine does not evaporate the full quantity of water that its boiler would otherwise be capable of evaporating per minute."

Mr. Parkes either knew these facts, or he did not. If he did, he lies under the imputation of having brought a charge against M. de Pambour which his reasoning powers must have told him, had he exercised them at all, he could not substantiate. If he did *not*, on which side does the "gross ignorance" lie? I can tell Mr. Parkes, that many persons of, perhaps, equal knowledge and skill with himself, are ready to plead guilty to an association with M. de Pambour in his "ignorance," if such it be.

But is Mr. Parkes himself perfectly immaculate, touching this cataract? He says, "The cataract is used for the purpose of opening the steam induction valve, and its value is appreciated as a means of effecting the influx of steam into the cylinder in the most instantaneous manner." Again, in his second paper on the percussive action of steam, published in the 3rd volume of the Trans. Inst. C. E., (Note E, p. 430,) we find, "No apparatus *for opening steam valves* with rapidity, and, therefore, for letting loose the steam upon the piston of an engine, with the full velocity due to the difference of the elasticities existing in the boiler and in the cylinder, has yet been applied so effective as the *cataract*."

Now, as it happens, the *cataract* does *not* open the steam valve at all, except on the "House-that-Jack-built" principle. It only *removes a catch*, which *lets fall a weight*, which opens the valve, and effects, &c. The removal of the catch, which is all the *cataract* does, might be done just as well by the plug rod, or by hand, or by a thousand other contrivances, as by the *cataract*. It is *the fall of the weight* which effects the instantaneous opening; and therefore what merit can belong to the *cataract* on this score, it is not easy to see. It might as well be said to be *valuable* as a means of pumping the water from the mine, for it is quite as much instrumental to one as to the other.

It would have been well had Mr. Parkes removed this "beam from his own eye," before he began to find fault with the "mote" in M. de Pambour's.

I remain, Sir,
Yours, with respect,
VINDICATOR.

London,
Feb. 1842.

ON THE FORCE OF FALLING BODIES, AND PILE-DRIVING.

SIR—In the *Journal* for last month, after the description of the "American Steam Pile-driving Machine" with which you favoured your readers, there are some judicious remarks on "the force of the blow given by the ram of a pile engine," and a table calculated from the formula $32\frac{1}{6}\sqrt{\frac{s}{16\frac{1}{12}}}$ for finding the velocity of a body falling from the height s, for the force in tons; the weight of the falling body being one ton. Now it appears to me, from want of defining an unit of force, and the force in tons therein given, this table may be mistaken for a mere weight acting by pressure without any velocity, by persons not acquainted with the principles from which it is derived. Would it not, therefore, be well to define the unit of force, as you have taken it, to be *the weight of the ram moving with a velocity of one foot per second?* In page 255, Vol. II., July, 1839, concluding some remarks on this subject, I gave an example founded on the above principles, that is, taking the force used in driving the piles as the weight multiplied by the velocity, and comparing this with the weight of the superstructure, supposed also to be for the comparison a moving force.

In the Mechanics' Magazine for December 30, 1836, No. 175, a correspondent, in answer to a question on pile-driving, says the force of a ram falling from a height of 1¼ inches is double its weight, and a correspondent, B, in your Journal for August, 1839, states from some experiments on a spring balance, that one-half the weight, falling with a velocity of ⅔ foot per second, is equal to the [illegible]ct; which is to say, that the whole weight moving with a [illegible]r second, produces an effect equal to twice [illegible] of [illegible]lling fr[illegible] 1¼ inches acquires, [illegible] v[illegible] nd. This would, therefore give $\frac{1}{4}$ the less effect than B's experiment; or a velocity of 1·3 foot per second for a force equal to the weight, B's being a velocity of 4 inches, when the force equals the weight. The unit of force adopted by you lies between these. However, the truth is, little dependance can be placed in any comparison of this kind from want of analogy. But it appears to me the velocity $\frac{2}{3}$ foot per second given by B, produces an effect equal to the weight, and not its double, in his experiments.

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* See *Journal* for June last, p. 210, Vol. IV.

† Since writing the above, it has come to my knowledge that an order for eight pairs of engines, *upon the direct action* principle, of 400 to 500 horse power each, has been decided upon by the "Government folks," and this with "Vulcan's" paper before their eyes!

Much good would result from persons registering and publishing the following data, when engaged in pile driving. *The piles*—timber, or other material, of which they are composed; weight and length; top and bottom sections; surface, whether rough or otherwise; weight and shape of shoeing; head, whether furzy or strapped. *Ground*—the different strata passed through, and their depths; the depth driven at each stroke, with the weight of the ram, and the height it fell from. These data would be of great benefit to the practical man, and would furnish materials to the theorist, who, in examinations of this nature, fails most often from not taking in all the circumstances, or from defective data.

Dundalk, Feb. 7, 1842. JOHN NEVILLE.

Sir—It appears that a difference of opinion exists as to the amount of force with which a moving body strikes one at rest, as applied in the case of pile-driving. This difference of opinion probably arises from considering the force of impact as momentary; but a force of this description is quite imaginary, and cannot be assigned, unless we can comprehend infinity. Now if one man can raise one ton one foot high in one second, he can raise it two feet in two, &c. And whatever amount of force is expended in raising it will be measured by the free descent of the same weight through the same space, for if it were greater or less, the perpetual motion would be possible; therefore, on mechanical principles it must be equal. Hence a body raised to any given height may be considered as an accumulation of force equal to that which has been expended in raising it to that height; and the amount of this accumulation evidently includes two considerations—the amount of force employed, and the time of its employment. Now this accumulation being a certain definite amount of force, its expenditure will be regulated by the same laws as that which produced it. If, then, a certain amount of force be expended to raise a body one foot high, and this body fall through the same space, its momentum will be equal to the force which has been expended in raising it. Let it, after falling through this space, strike a body at rest, and by the force of impact carry it through an equal space, the whole amount of accumulated force being destroyed to effect this, the increments of the generating and destroying powers may be conceived as nearly equal, but not absolutely, for the descending body is supposed to descend through a greater space than it had been raised through, on account of its forcing the resisting body through some space, but as this is small and passed through slowly, it is of no practical moment. If, then, a body fall through 10, 20, or 30 feet, and carry a resisting body through $\frac{1}{100}$ of a foot, the force being destroyed to effect this, the force of impact will be proportional; that is, as often as $\frac{1}{100}$ of a foot is contained in 10, 20, or 30 feet, so will the weight of the descending body be to the force of impact.

That such is the law of impact is plain, for if a falling body could strike one having a velocity equal to its own in the same direction, the force of impact would be nothing; it would be simple contact. If the velocity of the body struck were less than its own, the force of impact would vary in proportion, and its limit is absolute fixedness without elasticity: in the first case it is nothing, and in the last it is infinite. The elasticity of all bodies is similar to that susceptibility of matter to be moved from place to place: it is a property of matter opposing resistance to force; and, as it relates to this question, it is nothing more.

Applying, then, these almost axiomatic truths to the case of pile-driving. Let a be the space the ram descends through, b the weight of the ram, s the space the pile is driven by a blow, and y the force of impact; then we have $\frac{ab}{s}=y$.

Now what practical deductions can be made from the preceding remarks? —the limit to pile-driving is the elasticity of the material driven. When atter to be driven through is of such a nature as to resist the penetra- he pile with a greater force than is measured by the elasticity of the material of the pile, further driving would be impossible. For instance, if the elasticity of the pile be $\frac{1}{25}$ of a foot, the force of impact being 600 tons, further driving would be impossible.

It is stated in your Journal for December last, that the force of impact 600 tons is the greatest blow that can be given by the pile engine imported from America. The weight of the ram is 16 cwt., the descent 30 feet. Modifying the preceding formula, we have $\frac{ab}{y}=s$, and calculating from the above data, $\frac{30\times 16}{600}=\frac{1}{25}$ of a foot.

Now if the limit of a pile engine's power be to strike a blow of 600 tons, it is because the effect is lost in the material struck. In the succeding number of the *Journal* it is stated that the ability of this pile engine to strike with a force of 600 tons is an exaggeration; but if the above principles be correct, that assertion is a mistake.

It is a question of some practical importance to assign the weight of superstructure a pile will bear. The determination of y in the above equation is the answer. For instance; if the weight of the ram be one ton, the descent 20 feet, the distance the pile is driven by the blow half a foot, then $\frac{20\times 1}{0{\cdot}5}=40$ tons, the weight that would be required to sink it; a less amount would not. If the distance which the pile sinks at each blow be small, the elasticity must be taken into account; its effect is to diminish the result of each blow, that is, to make the divisor less than truth; the quotients would, therefore, be too large.

Objections might be made to what is here stated. In relation to elasticity, it might be said that the whole amount of force being communicated to the pile, it could not be lost; but its effect is to distribute the blow over a longer space of time. It might be also said of two rams of different weights, say one half that of the other, falling from the same height, that if the heavier was required to sink the pile, the other would not. If effects be proportional to their causes, the less would sink the pile half the distance of the other, and the quotient would then be the same.

I am, Sir,
Truly yours,
London, Feb. 10, 1842. W. G.

Sir—I read with considerable interest, in your January No., a description of the American Steam Pile-driving Machine, and, having seen it myself, can bear testimony to its accuracy; but the table with which that description concludes is so manifestly erroneous, that attention should be called to it. The table *assumes* that a body of one ton weight, falling through one foot, would strike a pile or other object with a force equal to 8 tons, and the same weight falling through 16 feet would strike with a force equal to 32·1 tons; so that, although the weight had been *raised* through 16 times more space in the latter than in the former instance, and, of course 16 times the power expended to raise it, yet (according to the table,) the effect produced by striking a pile is only quadrupled: what then has become of the remaining 12 parts of the power exerted in raising the weight, seeing only 4 out of the 16 have been spent in striking the blow? Had the column headed "Force in tons for a ram weighing one ton" been "Acquired velocity in feet per second," it would have been about correct. Now the force exerted by a body in motion, when striking an object, as a pile, is as its weight and the *square* of its velocity, which has been long since demonstrated by Smeaton and other writers. Assuming, then, with the author of the table before-mentioned, that a ram of a ton weight, falling through a foot, would strike a pile with a force of 8 tons, and as it would have acquired a velocity of 8 feet per second, the same ram, falling through 16 feet, would have acquired a velocity of 32·1 feet per second, or 4 times the velocity in the former case; now $4^2=16$, and 16×8 tons$=128$ tons, instead of 32·1 tons, as in the table.

There is, however, no authority for proving that a ram, falling through one foot, would strike a pile or other body with a force exactly equal to 8 times its own weight. I am inclined to consider its power much greater than this, though the precise amount it would exert as compared to a quiescent weight, I am not prepared to answer; indeed, it is a question undemonstrated by any writer I am acquainted with.

The laws relating to the *comparative* forces exerted by bodies in motion of different weights and different velocities are well known, but the *absolute force exerted by any body in motion striking another body, as a pile,* compared with a weight in a *quiescent* state, is well worthy of investigation; though it may be doubted if the one can ever become the standard of measurement for the other. Any of your readers having time and opportunity to investigate this subject, would confer a benefit of great practical value.

I remain, Mr. Editor,
Yours very truly,
Jan. 19, 1842. S. C. H.

[We reserve our remarks on the above communications until next month. —EDITOR.]

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.

(Concluded from page 98.)

IN the ensuing lectures he should endeavour to illustrate the following points—1st. The principles on which railways should be laid out under various circumstances of traffic, and topographical feature. 2nd. The comparison of different systems of inclinations or gradients. 3rd. The analysis of the advantages of various breadths or gauges. 4th. The illustration of the different modes of forming the railway proper, or upper works. 5th. The investigation and explanation of the great works of construction, as peculiarly found expedient in forming railways. 6th. The practice of framing estimates, and the necessary details connected therewith. 7th. The consideration of the various modes of working railways by animal and by mechanical power, locomotive and stationary. 8th. The inquiry into the working expenses and annual charge on railways; and, concluding with a summary lecture, in which the general features of the course will be given, and drawing such prominent inferences as might be most useful and interesting. The other branches of internal communication, as well as the various and numerous subjects connected with the theory and practice of a civil engineer, must be taken up on other occasions. Reserving, then, the elucidation of the details under the several preceding heads for the class room, he would proceed to make a few general remarks. Of these, the most prominent and most important, in his judgment, and most to be impressed upon the mind of those about to enter the profession of a civil engineer, was that connected with the great excess of actual expenditure in the construction of railways over estimates, for not only has that unfortunate, and almost invariable occurrence brought discredit on each concern so affected, but it has paralysed, and will long continue to paralyse, the most honest and well-grounded schemes for further internal communication in general, and of all improvements, the cost of which is dependent on the engineer; and though each case ought to be tried and judged on its own merits, the public confidence appears gone, and the capitalist observes with a sneer, "You engineers are all alike; we can trust none of you." Now, without shrinking from his own individual share of the odium thus cast upon the profession, as far as it may truly be deserved, the Professor denied the general and sweeping imputation, and he called on the directors of public companies, in justice to themselves, to their subscribers, to their own engineers, and to the public in general, to publish such details as would exonerate his profession, and leave it charged with no more than what was attributable to it. He called upon his brother engineers to follow this out, by furnishing their quota of information. Let the public in general know these details as matters of railway statistics of the highest interest—let the profession know them as matters of precedent of the most valuable kind—and let the capitalist be undeceived as to his present impressions of mistrust. Quite independent of any financial difficulties—quite independent of any standing orders or regulations of Parliament—a man might as well cry "mad dog" as talk of a new railway speculation, or a water-work, or, indeed, any public undertaking, where the function of profits is a certain known quantity, but dependent on estimates which are considered visionary, because "all engineers are alike in this respect." Let, then, the young engineer mark well the bitter lesson the oldest engineers are now learning—let them cause [the most assiduous inquiry into the details—the most unremitting toil in gathering information—storing their minds, exercising their memories, practising their hand, and working out their calculations—let them remember that by working drawings, by models, and by every *a priori* means of unceasing investigation, they must "first and truly calculate the cost" of what in future life they may be called upon to undertake. If the matter be ever so trifling, they must not shrink from the truth, or attempt to disguise it from themselves, still less from their employers. Let them never have it said of them that they had whispered amongst themselves, "Oh! it will never do to tell the directors what the work will cost, or it will never be entered upon"—a remark which he had heard fall from an eminent engineer; nor let them indulge in the vain hope of future fame, by taking as their text the observation attributed to another engineer of the very highest, and well-deserved, reputation—"A century hence there will be no one who will ask what this work cost, they will only inquire who did it."

He begged to repeat, then, what he stated at his first introductory lecture, that the constant maxim the young, as well as the old, engineer should keep before him is—"That the success of an engineer in this country of private enterprises and individual exertions, depends not upon the beauty or the cost of his constructions, or as mere works of art, but on their success as profitable and mercantile speculations." They must not suppose this to be an ignoble maxim; it must be followed out to its true results, and then they would find that prudence, caution, economy, judgment, and the highest intellectual gratification follow closely in its train; for, to apply the words of Mr. Booth, the intelligent secretary of the Liverpool and Manchester Railway, and one of the fathers of the modern railway system—"The contemplation of what is passing in England (alluding to the first cost of railways,) must not be without its lesson, for, in all countries, and under all circumstances, it is an object worthy of a statesman, to prevent the reckless waste of the national means, and to give a right direction to the public expenditure." And shall it be said that it is not equally worthy of an engineer? What are the aggregate subscriptions of associated and incorporated bodies of individuals but great portions of the "national means," which should not be wasted by the statesman or by the engineer? What are the monies invested in railways but a part, and, in the United Kingdom, a most important part, of the "public expenditure?" And is it not at once the duty, as it ought to be the pride, of an engineer, to give that expenditure a "right direction?" Let the maxim he had laid down be duly followed out, and that duty would be accomplished. The learned Professor continued, by stating that, even at the risk of having motives attributed which he should be unworthy of public or private estimation if he entertained for a moment, he would call the attention of the student to an instance of great expenditure on railways. The perfect completion in the manner contemplated of the internal communication by railway from London to the Sussex coast, a distance of little more than fifty miles, will amount, in the aggregate, to nearly four millions sterling. Is not that a reckless waste of the national means? Is that a right direction of public expenditure? Will not the public, in some way or other, pay for that?—the subscriber or the traveller, or both? To quote the words of an intelligent and experienced railway man—"With such results before us, would it not be almost criminal not to endeavour to secure the advantages of a better system?" The average cost of the railways in England has been very nearly £30,000 per mile. The cost of future lines must not be more than one-half of that sum, or it may be considered that there is an end to the extension of the railway system. The Professor stated that it would be his attempt to explain, in the course of his lectures, his ideas, that such a reduction in the expense might easily be made, and he would show that they were founded upon practical experience. The profession would be greatly aided, and the public vastly benefitted, if the railway companies and their engineers would publish the detailed accounts he had asked for, to serve as a beacon, for which all would be very grateful; and it was his deliberate opinion and recommendation, that if they would not do so, Parliament ought to give the railway department of the Board of Trade powers to enforce such returns.

The total amount of capital invested in the railway speculations of this country is probably little short of £50,000,000, and the total extent of lines about 1700 miles—most of which are now completed. This may be said to be the creation of the last fifteen years. The total length of navigable canals in Great Britain is nearly 2500 miles; they were chiefly formed in the last 40 years of the preceding century. The capital invested in this branch was about £20,000,000, with an annual expense of about 50*l.* per mile. In addition to canals, there are about 1500 miles of navigable rivers. The turnpike-roads of England and Wales are stated, in official returns, to be nearly 20,000 miles in extent, executed at an expense of at least £20,000,000, and maintained at an expense of about £1,750,000 per annum, and all formed within little more than a century, exclusive of other highways, in length about 100,000 miles, with an annual expense of 12*l.* or 13*l.* per mile, or 75*l.* per mile for maintenance. The extent of executed railways in the United States of America appears to be about 4000 miles, executed within the last fifteen years, at a cost of about £8,000,000, or about £5000 per mile; most of them are single lines, and it is stated that the average net income has been about 5 per cent. per annum. The extent of railways in Belgium is now about 200 miles, executed at a cost of rather more than £1,500,000, or about £8000 per mile; most of these are single lines, and have all been executed within the last ten years.

The average annual expense of maintaining the railways of England (exclusive, of course, of moving power, carrying and managing establishments, &c.) appears to be from £200 to £300 per mile per double way; but on the Dublin and Kingstown Railway, where the system of longitudinal timbers for the upper works has been completely carried out, the same heads of expense are now reduced to less than 50*l.* per mile per annum, with a locomotive traffic over that railway as great, if not greater, than over any one in Great Britain. The average expense of the canal maintenance in this country seems to 50*l*. per mile per annum.

The Professor concluded by stating, that he would close his somewhat desultory discourse by calling attention to the fact, that the first elements of the amelioration of internal improvements, he would not say internal communication, which arose in this country, date from the period of the introduction of the Poor Laws into England, the effect of which has been to compel the rich to find employment for the poor, or to support them, and thus has been carried out the great principle of self-dependence, in separate districts, to work out their own improvements. Certain it is, that, from the passing of the Act of Elizabeth, which instituted a legal maintenance for the destitute, and, by making mendicity a crime, swept the hordes of beggars, idlers, and sorners, from the face of the land, this country took a start, and, overtaking in improvement the other states of Europe, then far in advance of her, has since pursued that successful and continued march of amendment of her internal communication, which forms so remarkable a feature of England, proving her wisdom and proclaiming her prosperity. He begged that, with his previous cautions, the students would remember that the agent for the carrying out of such improvements, past and to come, has been, and he trusted long would continue to be, the civil engineer.

ON ARCHITECTURAL CRITICISM, &c.

To Mr. East, with a word to H. S.

I shall be glad to be allowed to correct an error into which Mr. East has been led by the mystical signature of another correspondent, since he attributes to me a certain harsh voice which emanated from "Ditto." At the same time, I must acknowledge myself unable to comprehend the meaning of many of the hints, which is to be attributed to their not being written in a simple style, suited to the difficulty of the subject. That much of their obscurity arises from the manner of writing, I am led to infer from my total ignorance, after five careful perusals, of the meaning of the first paragraph addressed by mistake to me.

This will be, perhaps, the best opportunity for saying, that the whole of H. S.'s last communication might be readily inferred from the first; but they neither of them afford the explanation required, viz. how to account for the extension of precedent worship from Grecian to Gothic, and that a time when the classics have more than begun to find their proper level in every liberal education—when this age has the character for carrying utilitarianism and the study of science, if possible, to excess, and when general literary and scientific institutions are springing up in every direction.

If the cause stated by H. S. is correct, we are now only suffering from the effects of a past evil, and may be sure of a speedy reformation. As a proof of this, we need only refer to the programme of the University of London for the B.A. examination, where the classics form less than one-twentieth part of the course of study required. That there is a considerable movement in the architectural world in this direction, I may mention that the doctrine promulgated in the essay to which the medal of the Institute was awarded on the 28th of February last, was in unison with that of H. S., Ditto, and myself; and that it appeared to be received with general satisfaction.

J. L.

ACADEMY OF SCIENCES.

Jan. 24.—M. Pelouze read a report on a memoir communicated some weeks since to the Academy of Sciences at Berlin, by M. Magnus, on the experiments by M. Gay-Lussac and M. Rudberg to ascertain the dilatation of gas. M. Gay-Lussac had arrived at the conclusion, that what is called "the arithmetical co-efficient" of the number expressing the rate of dilatation, should be expressed by the decimal number ·00375. This was the supposition that the volume of gas was measured under a constant pressure; but M. Rudberg had fixed the same co-efficient at ·003646, by measuring the gas under a variable pressure. M. Magnus had repeated these experiments, and had arrived at results much nearer those of M. Rudberg than those of M. Gay-Lussac. This he attributed to a defect in mercury, as being unfit for exactly closing the apertures and joints of the vessels receiving the gas, notwithstanding that the use of mercury for these experiments was recommended by M. Biot in his *Traité de Physique*. M. Magnus had experimented on different gases and gaseous fluids, and had found the following co-efficients of dilatability: viz., air .003665, hydrogen .003656, carbonic acid .00369, and sulphuric acid .003856. It would appear doubtful whether the dilatability of gas remains always constant, and whether it may not vary under various pressures.

Feb. 1.—M. Ebelmen read a memoir on the nature of the *various vapours developed in smelting furnaces*, as observed at different altitudes within the furnaces. The object of such researches was to determine the degree of heat at various points, and to devise means for the improved regulations of the fires. He has arrived at the following results.—1. The gaseous vapours, on coming out of a furnace heated by charcoal or wood, contain watery vapour, carbonic acid, and oxides of hydrogen and azote, but no carbonated hydrogen. At 6 or 8 feet below the mouth of the furnace the watery vapour is not found, and the proportion of oxide of carbon increases, while those of hydrogen and carbonic acid diminish, according as the observations are made lower and lower down in the furnace.—2. When coal is used jointly with wood for heating the furnace, the carbonization of the vapours takes place in an internal zone, and the water is expelled from the metal at a very low altitude. He found that the proportion of gas which traverses a certain zone of the furnace per minute, is greater according as it is further from the bottom of the furnace.

The Minister of Commerce communicated to the Academy some observations from the Industrial Society of Mulhausen, on the importance of adopting an unit of measure for the force of machines, considered not only in the power exerted, but in the time required. The Society observed, that the usual estimation of horse-power was not uniform, and proposed that the unit for France should be the force required to raise one kilogramme to the height of a metre in a second. To this unit they proposed that the name of *dyne*, from the Greek root, signifying "moving force," should be applied, and then that it should be compounded with Greek and Latin words, in the same way as the metre, the gramme, &c. Thus the *kilodyne* would signify a thousand times this unit, and the *millidyne* would signify the thousandeth part of the same unit.

M. Arago read a communication from M. Rusiger, a German geologist, on certain geometrical observations, made in order to ascertain the relative altitudes of the Dead Sea, in Palestine and the Mediterranean. It appeared not only that the surface of the Dead Sea was 219 toises, or about 1,314 feet lower than that of the Mediterranean, but also, from the geological phenomena observed on its shores, that the formation of the basin in which it lies was antecedent to all historic epochs. Hence the supposition that the sea was formed by the sinking of the plain on which the cities of the Pentapolis (Sodom, Gomorrah, &c.) were situate, is incorrect. M, Arago added, that the observations of M. Bertou, a French engineer, made the depression of the Dead Sea below the Mediterranean 419 metres, or 1,374 English feet.

Feb. 7.—M. Arago gave an occount of two memoirs by Mr. Dove, "*On the Phenomena of Chemical Induction.*" An electrical current causes, in a mass of iron placed near it, two kinds of phenomena—one corresponding to magnetism, the other to dynamical electricity. The author of these memoirs announced that he had succeeded in separating the two classes of action, by giving them different degrees of relative intensity; and he had shown the magnetic action to exist in substances where its presence had not been suspected.

M. Vallé, colour-dealer, submitted to the notice of the members some specimens of *canvas for oil-painting*, covered with a substance intended to preserve the colours laid on it from all effects of moisture.

Feb. 14.—A communication was read from M. Combes, on a supposed cause of the contortions of the metallic tube in the bore of the well of Grenelle.

Extract of a memoir, by M. Bessell, on a phenomenon of atmospheric light, which appeared to be the reflection of a fire on the earth from the surfaces of clouds, which were probably frozen.

A note was read from M. Mallet, of St. Quentin, upon some further improvements in the purification of gas. He had succeeded in depriving gas, not only of its ammonia and its sulph-hydric acid, but also of its empyreumatic products and of its naphthaline. The gas, thus purified, was found to retain only a very slight empyreumatic smell, very different from the fetid odour which it commonly possessed.

M. Nothomb informed the Academy that he had found considerable advantage, in photographic operations, resulting from the use of protochloride of mercury, instead of pure mercury, as originally used by M. Daguerre.

Feb. 21.—Some curious experiments were mentioned as having been lately made by Capt. Bailly, of the engineers, on an artesian well at Lille, which had exhibited some remarkable phenomena of intermission in the discharge of the water. M. Bailly had proved that these intermissions corresponded with the tides at Dunkirk.

M. Arago read a communication from Mr. Nasmyth, an English engineer, stating that it had been observed, on several lines of railroads in England, that the rails never rusted when they were traversed by wagons going always in the same direction; but that when they served for wagons going in opposite directions, as in the case of a single line of rails, they became rusted very soon.

Feb. 28.—M. Arago gave an account of the proceedings of the commission on the question of inventing either an indelible ink, or else a "paper of safety," in order to prevent forgeries. It appeared that the invention of an indelible ink was given up, as insufficient for the purpose, and that the efforts of competitors for the premium of 36,000 fr. offered by Government in 1836, were now directed to the making of the safety paper. It had been proposed to cover the paper with a kind of vignette, or tool-work, in an ink that should be in part liable to be effaced; so that if any attempts should be made to alter the writing or printing on such paper, the vignette work would

WEIGHTS AND MEASURES.

At one of the evening meetings of the Professors of University College, Mr. De Morgan discussed the recent report of the commission on the new standard weights and measures. The imperial standard yard and bushel, constructed in pursuance of the statute of 1826, were destroyed by the conflagration of the Houses of Parliament, and a committee of men of science was appointed to consider the best mode of restoration. The statute had directed their restoration by what is called a natural method—the measure of the length of a pendulum swinging seconds in the latitude of London, under certain conditions, but the progress of experiment has induced the commission to repudiate that method and to recommend the adoption of the old plan of having standards constructed. It is to be observed that the experiments of Kater, Baily, Bessel, and others, have of late years shown, that as regards the pendulum, the amount of correction due for the pressure of the atmosphere, level of the sea, terrestrial disturbance, and other causes, is far from being ascertained. Professor De Morgan, indeed, intimated strong grounds for the non-existence of any such thing as a natural standard. Fortunately, it has happened that the Royal Astronomical Society possesses a copy of the standard yard, and from this the Commissioners propose that the new standards should be restored. Speaking of standards, Mr. Baily reported to the Astronomical Society that the old standard yard, made in the time of Queen Elizabeth, and preserved at the Exchequer, was in existence four years ago, when he saw it. It is described as a most disgraceful specimen of workmanship, being little better than a common kitchen poker, filed at each end, while at some distant period it had been broken in the middle, and the point dovetailed and left loose, so as to bend like a pair of tongs. Of this implement copies used to be furnished by the officers of the Exchequer to foreign men of science, accompanied with a parchment certificate, on which the stamp duties were four guineas, besides official fees—a circumstance truly designated as productive of national disgrace. Several copies of the new standard measures are recommended by the Commissioners to be preserved for use in different parts of the country, and four sets to be imbedded for preservation in a stone in the foundations of the new Houses of Parliament, and only to be removed by the authority of the legislature. The other recommendations are—the abolition of the troy pound; the establishment of a new long measure; and the introduction of a decimal coinage. The Commissioners propose that a measure of one thousand yards should be authorized to be used, and should be adopted by Government in the mensuration of public works, &c. This is not proposed, for the present, to supersede the mile, but to work concurrently with it; and they suggest that the new measure should be called a milyard, a name rightly designated by the Professor as a barbarous mixture of Latin and English. He observed that the old English mode of combination is exemplified in the word furlong, which signifies the forty long, that is, forty poles long; so he would call the new measure a thousand long, which would, like other words, ultimately be abridged by the public. He remarked that we have already a decimal system, which has been introduced without the authority of Magna Charta by the example of one man, and which has now become engrafted on the whole system of our landed property—he alluded to the surveyor's chain of one hundred links, the extension of which as the standard measure of length he much wished to advocate. The Professor did not say how he would apply this, but as it is a subject in which our professional readers should interest themselves, we shall make some remarks upon it. We have already the chain, and furlong of ten chains; the next step in ascent is a *new* mile of ten furlongs, being one old mile and a quarter. This new mile would be nearly equal to two French kilometres, or as 2200 yards to 2187·22, or a difference of only 12·77 yards, or little more than one half per cent.[*] Descending from the chain, we should have a fathom of ten links, (6·6 ft.) being nearly the same as the new French toise, or as 2·0116436 to 2½, and only six inches more than the common fathom. The tenth of the new fathom, or toise, is the link of ·66 of a foot, or nearly two-thirds of the present foot, and the tenth of this link or foot will give a new inch of about four-fifths of the present inch. Were our professional readers to take this subject in hand, and give it their support, we have little doubt that, either with or without Government aid, they woud be able to carry out the chain standard. At the same time, we must call their attention to the serious evil which will accrue to them from the adoption of the milyard or thousand-long, which will not work well with the chain, and will create the greatest difficulty in all land measurements, and much confusion as to landed property. The first step would be the adoption by the naval service and by engineers, architects, and surveyors, of the fathom of ten links, which will prepare the way for its general adoption. The close resemblance between the chain measure and the French metre system is a farther recommendation.

"The first step" says Professor de Morgan, "to decimal weights and measures is a decimal coinage, a system which the Commissioners have recommended generally, without laying down any particular plan." Mr. De Morgan's proposition is for a gradual introduction of the plan. He would, in the first instance, without any Act of Parliament, introduce a two-shilling piece, and withdraw the half-crown. To this two-shilling piece, it would be advantageous to assimilate to the East India Company's rupee, so as to make that important branch of our currency uniform with that of the seat of empire. He would then coin a piece of twopence-halfpenny, five of which would make a shilling and a halfpenny, and ten a two-shilling piece and a penny. The working of this would be, he considers, to produce practically the fifth of a shilling; for the public would, in most dealings, make the tradesman give them the advantage of the halfpenny or penny, and so in the end decimalize the two-shilling piece. He would then, by Act of Parliament, reduce the nominal value of the copper coinage four per cent., by which the farthing would become the thousandth part of a pound, and the decimal system be established.

STEAM NAVIGATION.

The West India Mail Steam Packet Company's Steam Ship "Trent."—We have been much gratified by our visit to this vessel, which left the Thames on the 27th of February. The machinery is by Messrs. Miller, Ravenhill & Co., and in every particular of its structure, proportionment, and disposition, manifests the most eminent engineering ability. There is not a detail in the whole of the machinery which is not calculated to excite the conviction that its specific character is the result of the study of an able mechanician, and that its adoption has been the consequence of mature reflection, not of an inconsiderate reference to existing modes of construction. The power of these engines is 430 horses; the diameter of the cylinder 74 inches; the length of the stroke 7 feet. The condenser, the cylinder bottom, the air-pump bottom, and the support for the main centre, are cast upon the foundation plate. The condenser is beneath the foundation plate, so that the main centre does not pass through it as it does in many engines. The framing has been constructed with reference only to the strains to which it will be subjected, and without any attempt at what is termed architectural decoration; with one exception, where it could not be effected, all the principal joints are metallic, that is, the metallic surfaces of the joints are planed, and so accurately fitted as to be perfectly tight without the aid of rust, or without any substance interposed except a little red lead. With a view to increased durability brass and copper have been introduced with an unsparing hand, many of the parts which are made of iron in ordinary engines being of brass or copper in these.

The performance of the engines attests the skill and care concerned in their production. They work with great smoothness and efficiency, and with a consumption of only 16 cwt. of coals per hour. With a pressure in the boiler of only 3·78 lbs. per square inch, the mean pressure on the piston is 14·17 lbs. per square inch. The difference between the vacuum in the condenser and the vacuum is only .28 lbs. of pressure per square inch.

We are unable to enter into further details respecting this machinery at present, but we purpose next month to give a description of the machinery of the *Isis*, which started on Tuesday, 29th ult., also by Messrs. Miller, when we shall enter more fully into the merits of Messrs. Miller's arrangements, and hope to adduce good reason for our commendation.

MISCELLANEA.

Inlaid Ornamental Tiles.—Last month we noticed a work that had just been published, containing numerous examples of encaustic or inlaid tiles, selected from various ecclesiastical buildings in England: we are now enabled to announce that Messrs. Wyatt, Parker, and Co. have commenced the manufacture of these tiles. From the specimens sent us, we can judge that they will be found to be very durable, and far less porous than the ancient tiles, and will form an admirable addition to the architecture of our churches, by using them instead of stone or deal floors, in the side and centre aisles, and such parts as are not covered with seats; they may also, with equal taste, be used for lining the walls. The specimens now before us are made from Staffordshire clay of a dark red colour, and inlaid with yellow. Messrs. Wyatt have also sent us some specimens of pottery of an hexagonal shape, of various colours, for paving halls, dairies, &c., or for lining the latter; likewise small squares, from half an inch to an inch square for mosaic pavement. A variety of specimens of paving may be seen at Messrs. Wyatt's works.

Continental Machinery.—We perceive in the the *Eco della Borsa* of Milan, that extensive mills have been erected in Lombardy for spinning of cotton and silk, and that there is now being added another on a very extensive scale, for spinning and weaving of flax and hemp. It is undertaken by a public company, at the head of which is S. Battaglia the banker. It is situate near Milan, on the Adda. We observe that the entire direction of projecting and executing this new concern was confided in 1840 to Mr. Albano, C. E., of London: it is stated to be the most complete mill in all its details that has ever been erected. The powerful water wheel, and the mill gear for driving the spinning machinery, are of a superior description, and were made in this country, by the celebrated firm of W. Fairbairn and Co., of Manchester. In consequence of the prohibitory character of our export laws, the spinning machinery is to be made in Belgium, although the Company was most desirous that it should be made in England. Here is another example of the ruinous effects being produced upon the country, through the absurd prohibitory laws. We thus see that an order of several thousand pounds is taken out of our hands. How long this is to last it is impossible to say.

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[*] This new mile would be 55·6 to the degree, instead of 69½, and would be to the Irish mile as 2200 to 2240.

A Public Park at Liverpool.—The Liverpool papers state, that Mr. R. V. Yates has purchased from the Earl of Sefton forty-three acres in Toxteth Park, two-thirds of which are to be laid out for a park for the use of the public, and the remaining third is to be appropriated to sites for villas. The noble lord receives £1100 per acre, so that the purchase money for the whole will exceed £47,000. The land is beautifully situate, commanding fine views in every direction.

Steam Engines in Belgium.—It is estimated that there are now at work in Belgium 1300 steam-engines, with a total power of 33,100 horses.—*Galignani.*

Atmospheric Railway.—The report on this subject of Sir F. Smith, R.E. and Prof. Barlow, has been presented to Parliament. The summary of their opinions is thus given:—"1. That we consider the principle of atmospheric propulsion to be established, and that the economy of working increases with the length and diameter of the tube. 2. That the expense of the formation of the line in cuttings, embankments, bridges, tunnels, and rails, will be very little less than for equal lengths of a railway to be worked by locomotive engines, but that the total cost of the works will much greater, owing to the expense of providing and laying the atmospheric tube, and erecting the stationary engines. 3. That the expense of working a line on this principle, on which trains are frequently passing, will be less than working by locomotive engines, and that the saving thus effected will, in some cases, more than compensate for the additional outlay; but it will be the reverse on lines of unfrequent trains. However, there are many items of expense of which we have no knowledge and can form no opinion, such as the wear and tear of pistons, valves, &c.; on these further experience is needed. 4. That with proper means of disengaging the train from the piston in cases of emergency, we consider this principle as regards safety equal to that appertaining to rope machinery. There appear, however, some practical difficulties in regard to junctions, crossings, sidings, and stoppages at road stations, which may make this system of less general application."

Brick-making, &c.—A discovery has been made by Mr. R. Prosser of Birmingham, which bids fair to be attended with important results to the interests of architecture. The novelty of Mr. Prosser's process consists in the clay being dried, ground to powder, and submitted to pressure in metallic moulds, until the particles cohere together. As there is no water in combination with the clay, no drying process is necessary; consequently the articles made by this method are ready to be fired or burned as soon as they leave the machine. Owing to the great pressure required to cause the particles of clay to cohere together, the articles made by this press have greater density than those made in the ordinary way; they are also less porous, and not subject to decay in wet or frost. In addition to these advantages, any architectural device may be impressed upon the clay, which, when burnt, will retain all the sharpness of the original, however elaborately finished. By this process bricks may be made in all weathers, and with greater economy than by any other plan known at present. The brick-press is worked by hydraulic pumps, giving about 300 tons pressure, thus producing the adhesion and cohesion. The machine delivers the brick (four at a time in the present machine) ready at that instant for the kiln, requiring no exposure to the atmosphere to dry. The whole operation, from the time of putting the powdered clay into the machine to the delivery of the brick, occupies about half a minute. Machinery might readily be constructed to produce bricks fifty a minute.—*Daily paper.*

Architectural honours.—We are happy to announce that Mr. Cockerill has been elected a foreign member of the *Academie des Beaux Arts*, in the room of the late M. Antolini of Milan, and that Mr. Barry has been elected a member of the Royal Academy, in the room of the late Sir David Wilkie, an appointment that will give the greatest satisfaction to every architect: we have now *three* architects in the Academy.

M. Antolini.—The following notice of this eminent architect, who lately died in Italy, appeared in the *Art Union*:—"Cavalier Gio Antonio Antolini was born in 1754, of a respectable family at Castel Bolognese: he studied at Bologna, and there took a degree as an architect and engineer. He was called to Rome for the works on the Pontine Marshes, and at Rome he studied deeply the remains of antiquity, and published "Illustrations of the Temple of Hercules at Cori." He then went to Milan, where he designed the plan of the Forum Bonaparte. He was afterwards named to two chairs, those of Architecture in the Academy, and of Geognosy in the University of Bologna; and he was subsequently elected a member of many learned bodies, including the Institute of France. He held many honourable public appointments, and executed many works for the Italian government as well as for individuals; he was also employed in foreign labours, latterly for the Viceroy of Egypt. He has left, it is said, in his son Philip Antolini, the heir of his talents as well as of his name. He has published the following works, besides the above-mentioned:—"The Ruins of Velleja in the Piacentino;" "The Temple of Minerva in Assisi," confronted with the plates of Andrea Palladio; "Elementary Ideas of Civil Architecture;" "Notes to the Treatise of Architecture by Millzia."

Thames Tunnel.—We are happy to hear that this work is now *past all danger*, and that within a few months it will be open to the public as a thoroughfare. The entire brick structure of the Tunnel, uniting the two opposite shores, is now wholly completed.

Paris.—To the already numerous buildings which have been recently erected for the embellishment of the French metropolis, a new palace is to be added, for the Archbishop, on the Quai Napoleon, facing the Hôtel de Ville: it is to be in unison with the Cathedral of Notre Dâme. The beautiful turret and other fragments of the Hôtel de la Tremouille, whose demolition excited so much interest, are to be appropriated to the sacred edifice.—The colossal statue of "Immortality" by M. Cortot is about to be cast, and placed on the dome of the Pantheon.

Monument of Napoleon.—The French newspapers announce that the Government have ordered that the monument to Napoleon shall be executed according to the plan recommended by the Commission appointed to examine the competition drawings and models, who reported that none of the models were entirely satisfactory, and recommend to be erected a sarcophagus of granite or porphyry, of a severe and noble form, placed on a pedestal of an indestructible material, which appears to the Commission to be the most suitable monument which can be raised to contain the ashes of Napoleon. It should convey the idea of eternity, and that the remains of the great man are safe from the vicissitudes and accidents of time. It ought to be constructed in such a manner as to survive the destruction of the church which contains it, and the fall of the dome, and it should be impervious to fire. As to the objection to the plan of a crypt, that it is exposed to damp and to inundations, it is not true; the foundation of the Invalides is many metres above the highest waters, and its vaults are remarkably dry. The excavation of the crypt besides, renders any other appropriation of the dome impossible; it must remain for ever sacred to the ashes of Napoleon. The Commission further expresses the opinion that within the inclosure of the Invalides, but without the church, and quite apart from the tomb, an equestrian statue of the Emperor should be erected. It further expresses the wish that this statue should be represented in the Imperial costume, to mark that Napoleon is honoured not less as a statesman and legislator, than as a warrior. The tomb within the church—nothing, in the presence of God; without—the statue—glory, in the sight of men. It limits itself to recommending this programme—an open crypt within the Church of the Invalides, an equestrian statue of the Emperor without. The French Government have appointed Messrs. Visconti and Marochetti to carry out the design; the first for the architectural and the second for the sculptural.

Hamburgh.—The New Exchange, which has been building during the last five years under the direction of the architect Wimmel, is now finished. The noble simplicity of this edifice renders it one of the greatest ornaments of the city.

Munich.—Swankhaler has been selected by the King of Bavaria to execute a great work, to be called the "Pantheon of Bavaria." It is to be erected on the hill of St. Theresa, near Munich. On the summit is to be placed a bronze statue of Bavaria, fifty-nine feet in height, resting on a lion twenty-five feet high. Around, under open colonnades, are to be placed statues of the illustrious men of Bavaria.

Russia.—A monument of cast iron in the Byzantine style has been erected at Smolensk, by imperial command, in memory of the battles of 1812. It is placed on the Parade Plaz, opposite the King's bastion, which was the point where the battle raged most furiously on the 5th of August, 1812. The inauguration took place on the 5th of November last.

Warsaw.—A monument of cast iron has been erected on the Saxon Plaz, by command of the Emperor of Russia, to the memory of the seven Poles who fell in defence of the Russian power on the 29th of November, 1830. The plan is that of the architect Corazzi, chosen from among ten competitors. The octagonal base is of native marble; eight bronze lions support an iron pedestal, above which are four eagles of gilt bronze, their wings outspread; a shield is on the breast of each, on which is inscribed a map of Poland; from the pedestal springs an obelisk of cast iron. The octagonal marble base is 30 ells in diameter; the pedestal 8½ ells in height by 10 in diameter; the obelisk 25 ells in height, 6 in diameter at the base, and 4 at the top. The iron and bronze were both cast in Warsaw.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 25TH FEBRUARY, TO 23RD MARCH, 1842.

Six Months allowed for Enrolment.

William Newton, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for "*improvements in regulating the flow of air and gaseous fluids.*" A communication.—Sealed February 25.

Osborne Reynolds, of Belfast, Ireland, clerk, for "*improvements in covering streets, roads, and other ways, with wood; and also in the means of enabling horses and other animals to pass over such roads and other slippery surfaces, with greater safety than heretofore.*"—Feb. 25.

John Birkby, of Upper Rawfold, card manufacturer, for "*improvements in the manufacture of wire cards.*"—Feb. 25.

William Saunders, of Brighton, Sussex, gent., for "*improvements in apparatus employed in roasting and baking animal food.*"—Feb. 25.

Samuel Morand, of Manchester, merchant, for "*improvements in machinery or apparatus for stretching fabrics.*"—Feb. 26.

Benjamin Gillot, of Great Saffron Hill, cutler, for "*improvements in heating and ventilating.*"—Feb. 26.

Marc La Riviere, of London Fields, Hackney, gent., for "*improvements in the machinery for figure weaving in silk and other fabrics.*"—March 1.

Thomas Smith, of Northampton, plumber, for "*an improvement or improvements in water closets.*"—March 1.

George Carter Haseler, of Birmingham, jeweller and toy-maker, for "*improvements in the tops of scent bottles.*"—March 3.

Edward Slaughter, of Bristol, engineer, for "*improvements in the construction of iron wheels for railway and other carriages.*"—March 4.

James Clements, of Liverpool, manufacturer of toys, for "*improvements in composition for ornamenting glass and picture frames, and articles for* *interior and other decorations; also for the manufacture of toys and other fancy articles.*"—March 4.

William Palmer, of Sutton-street, Clerkenwell, manufacturer, for "*improvements in the construction of hinges.*"—March 4.

Henry Barron Rodway, of Birmingham, wine merchant, for "*improvements in the manufacture of horse-shoes.*"—March 7.

Thomas Henry Russell, of Wednesbury, Staffordshire, iron tube manufacturer, and Cornelius Whitehouse, of the same place, for "*improvements in the manufacture of welded iron tubing.*"—March 7.

William Newton, of the Office for Patents, 66, Chancery Lane, Middlesex, civil engineer, for "*an improved machine or apparatus for weighing various kinds of articles or goods.*" A communication.—March 7.

Thomas Hedley, of Newcastle-upon-Tyne, gent., and Cuthbert Rodham, of Gateshead, Durham, millwright, for "*an improved apparatus for purifying the smoke, gases, and other noxious vapours, arising from certain fires, stoves, and furnaces.*"—March 8.

William Catford, of Chard, Somersetshire, mechanic, for "*improvements in machinery or apparatus, for making or manufacturing lace or other netted fabrics.*"—March 8.

Henry Smith, of Liverpool, engineer, for "*improvements in the construction of wheels and breaks for carriages.*"—March 10.

Richard Beard, of Earl-street, Blackfriars, gent., for "*improvements in the means of obtaining likenesses and representations of nature and of other objects.*"—March 10.

William Edward Newton, of the Office for Patents, 66, Chancery-lane, Middlesex, civil engineer, for "*improvements in boilers, furnaces, and steam-engines.*" A communication.—March 10.

Charles William Firchild, of Woley Park, Northfield, Worcestershire, farmer, for "*an improved propelling apparatus, for marine and other purposes.*"—March 14.

Reuben Partridge, of Cowper-street, Finsbury, engineer, for "*improvements in machinery or apparatus for splitting and shaping wood into splints, for the manufacture of matches and other similar forms.*"—March 14.

Alfred Green, of Sheffield, surgical instrument maker, for "*improvements in trusses or surgical bandages.*"—March 15.

Edwin Ward Trent, of Old Ford, Bow, rope maker, for "*an improved mode of preparing oakum and other fibrous substances, for caulking ships and other vessels.*"—March 21.

Sydney Jessop, of Sheffield, merchant, for "*an improved mode of preparing wrought iron, intended for wheel tires, rails, and certain other articles.*"—March 21.

Zachariah Parkes, of Birmingham, manufacturer, for "*an improved mode of preparing wrought iron, intended for wheel tires, rails, and certain other articles.*"—March 21.

John Clay, of Cottingham, near Hull, Yorkshire, and Frederick Rosenborg, of Sculcoates, Yorkshire, gent., for "*improvements in arranging and setting up types for printing.*"—March 21.

William Hancock, the Younger, of Amwell-street, gent., for "*improvements in combs and brushes.*"—March 21.

Edward John Dent, of No. 82, Strand, chronometer maker, for "*improvements in chronometers and other time-keepers.*"—March 21.

William Brockedon, of Queen-square, Middlesex, gent., for "*improvements in manufacturing fibrous materials, for the cores of stoppers, to be coated with india-rubber, and used for stopping bottles ond other vessels.*"—March 21.

John Haughton, of Liverpool, clerk, for "*improvements in the method of affixing certain labels.*"—March 21.

William Palmer, of Sutton-street, Clerkenwell, manufacturer, for "*improvements in the manufacture and preparation of pills, and some other articles of a medicinal or remedial nature.*"—March 21.

Mark Freeman, of Sutton Common, gent., for "*improvements in the construction of inkstands.*"—March 21.

Robert Hazard, of Clifton, Somerset, confectioner, for "*improvements in apparatus for heating public and private buildings.*"—March 21.

Moses Sperry Beach, of Norfolk-street, Strand, printer, for "*improvements in machinery used for printing with type, and in the construction of type for printing.*" A communication.—March 23.

TO CORRESPONDENTS.

Seyton.—The plan for reversing engines is ingenious, but the drawing is badly executed, and the description contains several errors. The allegation that lap is inapplicable to a slide valve worked by a *fast* eccentric (i. e. an eccentric fast on the shaft), is erroneous. What is meant by "the expansion valves are constructed to cut off the steam till the end of the stroke?" If Seyton forwards us a proper drawing of his contrivance, *such as a mechanic might execute the work from*, we will consider of the propriety of inserting it in the next month's number. We are always desirous to encourage the efforts of young mechanics, and in the contrivance of Seyton we can discern much ingenuity and considerable promise.

Amicus Machinarum.—The project advocated by this correspondent of placing the air pump of a steam engine in the middle of the cylinder, is one of the wildest we have met with for many a day. The annular cylinder of Messrs. Maudslay is objectionable enough as it stands, even in the skilful hands of that eminent firm; but with our correspondent's improvement, this description of engine would have the merit of being the very worst at present existent.

The central cylinder in Messrs. Maudslay's arrangement is used for the purpose of obtaining a long connecting rod. This object our correspondent seems to appreciate very lightly, for he employs a short connecting rod of the Gorgon species, and into the vacant hole in the middle of the cylinder he places his air pump; the pump having the same length of stroke as the cylinder. It is the aim of engineers in general to keep the cylinder hot, but this gentleman has so far surmounted the prejudices of existing systems, that he has introduced a pump into the middle of the cylinder, for the purpose of keeping the cylinder cool. We are at a loss to imagine in what idea this crotchet could have originated; but we recommend our correspondent to forego all attempt at improvement until he has learned something of engines of the unimproved construction.

It is disadvantageous to make the stroke of the air pump equal to that of the cylinder. The valves are sure to strike very hard and wear themselves out very soon, when the bucket moves with a great speed.

Our correspondent's drawing is very neatly and, we may add, *skilfully* executed. We should be glad to find this peculiarity more common than it now is.

A Constant Reader, Greenock, asks us whether we approve of an improvement he has devised in the glass gauge tubes of marine boilers. We reply, decidedly not, unless it be our correspondent's object to render a very simple and excellent arrangement inefficacious. "In the boilers of marine engines," our correspondent observes, "a great agitation of the water often takes place from the ebullition, and at such times it is difficult, on account of the agitation of the water in the glass tube, to ascertain the real level of the water in the boiler." Our correspondent, therefore, proposes to lead small copper pipes from each extremity of the glass tube, where it communicates with the interior of the boiler, to a point considerably beneath the ordinary water level. Let us suppose this done; what will be the effect? When the water is first introduced into the boiler, it will rise in the two pipes connected to the opposise extremities of the glass tube, until its further ascent is resisted by the elasticity of the air shut within the pipes and glass tube. If this air be allowed to remain, no water will enter the glass tube at all; but the air may be allowed to escape by unscrewing the top of the socket which holds the tube. The water will then assume the same level in the tube that it possesses within the boiler. Suppose now that steam is got up, and the lower cock attached to the glass tube opened, so as to let some of the water escape, as is the usual practice, to make sure that there is no stoppage in the pipes. Upon shutting the cock, the glass tube will fill with water, not steam; nor is there any possible mode by which steam could obtain access to the upper part of the tube. Even if steam were, by any supernatural method, introduced, it would soon be condensed, by the escape of heat from the glass tube and brass socket, and the glass tube would refill with water. A glass gauge tube, therefore, if constructed after our correspondent's improvements, would be altogether inoperative as an indicator of the water level. The agitation in the tube our correspondent complains of may be stopped by nearly closing the cocks which sentinel the communications between the top and bottom of the glass tube and the boiler. It is beneficial also to lead a small copper pipe within the boiler, from the upper glass tube communication to a point some feet *above* the average water level, and another from the under passage communicating with the glass tube to a point some feet *beneath* the average water level. The sketches which accompany our correspondent's paper are of the rudest description, and his description of the construction and operation of the glass gauge tubes in common use is erroneous in several particulars. He shows no cock in the upper or steam communication between the glass tube and the boiler, so that if the glass tube be accidentally broken—and that, in steam vessels, is not an unfrequent occurrrence—the steam cannot be shut off, but escapes full bore into the engine-house. He says also that by opening the lower cock, and allowing the water to rush out, any little obstruction in the tube is cleared away. But if the water be allowed to rush from the lower cock from the boiler, it will not enter the glass tube at all, and, therefore, cannot be instrumental in cleaning it. It is by no means uncommon for glass gauge tubes to become so dirty, especially if the water be muddy, that it is difficult to see the height of the water in them. They are cleaned by being blown through with the *steam*, not by the *water*.

"*A Workman*" *on the Skew Arch.*—This is a paper investigating the method of finding *by calculation* what Mr. Buck terms the focus of a skew bridge and the eccentricity of its face. The problem has been previously solved by Buck in his Treatise, by W. H. Barlow, *C. E. & A. Journal*, No. 48, and, we think, by P. Nicholson, in his "Railway Masonry." The first part of the paper we cannot clearly understand, owing to the loose way in which it is expressed. He certainly, however, brings out no result from it. In the second part, relating to the eccentricity, he neglects, in consequence of its practical unimportance, the sine of a very small angle, and by that means brings out a formula which is certainly simpler than Buck's. Looking, however, to what others have written on the same subject, and considering the manner in which the paper is written, we cannot insert it in its present form; but as the writer evidently understands the subject, we shall be happy to insert it if he will make it more elementary, and more precise and accurate in its expression.

We have received several other communications, which we are obliged to postpone, together with reports of Lectures at King's College and London University.

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, III, and IV, may be had, bound in cloth, price £1 each Volume.

PROTESTANTISM AND ART.

1. *De Protestantismo Artibus haud Infesto. Scripsit* CAROLUS GRUNEISEN. *Stuttgartiæ et Tubingæ*, 1839, 4*to*.

2. *Der Protestantische Gottesdienst, und die Kunst*, 1840.

NOTHING, we conceive, but an over-scrupulous horror of the abominations of the church of Rome has induced the reformed church to repudiate, together with the creed and ritual of Rome, the services of those arts which, when legitimately employed to such end, enhance the decorum and solemnity of religious worship, rendering it more impressive. A very laudable indignation at the abuse of art in the theatric pageantry employed by Popery, and the grovelling superstitions to which it has been made to minister, has led us to run into the contrary extreme, and to reject it altogether, with somewhat more of narrow sectarian zeal than either prudence or real consistency.

Whether unjustly or not, the Reformation is generally charged, even by those who adhere to its doctrines, with having operated most unfavourably upon the fine arts, both architecture and painting. In consequence of Protestantism having withdrawn the patronage of the church from them, those arts, it is asserted, the latter more especially, have not only lost much of their influence and authority, but have actually deteriorated—have sunk down to a lower sphere, where they can no longer put forth their energies, and exhibit themselves in their majesty and splendour to all classes of the community without distinction. Painting may now be said to employ itself merely for the opulent, and for such of the other classes as have opportunities of visiting exhibitions, which are, unfortunately, so constituted as to minister quite as much, if not more, to frivolous curiosity—to lounging gossipping about art—than to art for its own sake, and in its better spirit. By far the greater mass of the population of this country have not the means of forming acquaintance with it in any shape, excepting it be that where we behold it sunk down to disgrace and deformity, without a trace left of its intellectual character, but grovelling down to the level of Jack-Sheppardism and Co. in literature. To the lower orders of English, painting is as unknown, its powers and capacities as undreamt of by them, as by the negroes in our sugar plantations, or the colonist in the back settlements of America. Neither is this the only consequence—whether an ill or merely indifferent one in itself—resulting from the exclusion of painting from churches and other places of social worship: since thus debarred from exercising their powers on an adequate scale, both the art and its professors are compelled to abate their enthusiasm, to lower their tone and their pretensions, and, instead of abandoning themselves to nobler impulses, thereby seeking to raise others to a calmer and loftier sphere, above the vulgar region of ordinary sympathies and affections, their high calling is more or less lost sight of, the ambition that would lead to great aspirings quite benumbed. Hence that branch of the art which is somewhat incorrectly termed historical painting, it being in fact that wherein its inventive and poetical faculties are chiefly exerted, declines, and sinks in public esteem; while those branches which confine themselves to matter-of-fact reality, and demand no loftier talent than manual dexterity of execution, usurp the place of the other, till *materialism* comes to be almost our established creed in art.

Pursuing the above train of remark, we might go on to show that when shut out from religious edifices, the species of painting here alluded to finds no other congenial abode—scarcely a place of refuge. Withdrawn from the gaze of the multitude, they learn to dispense with it, or rather have now to learn that the art admits of being applied more worthily than it at present is. On this account is it that while it is rejected by the church, it equally fails to obtain patronage from other public bodies. Our civic companies and other societies afford it no admittance within their halls, except in the humble quality of portraiture, or what is not a step higher removed from it.* Under such circumstances, little is to be expected from individual and private patronage, more especially for works of that high class on which the glory of the great Italian schools chiefly rests; because those who can afford to indulge their taste for such productions naturally prefer specimens of those schools—works of already established reputation. Besides all which, although our Protestant feelings are not shocked—whether they ought to be so, is another question—at meeting with many pictures in the galleries of our opulent collectors that are stamped most strongly and undisguisedly by the Romish creed and cultus, it does not follow that objections would not be entertained against religious subjects more consonant with our own belief. On the contrary, it is precisely because we have no reverential sympathy with them, that we do not feel at all scandalized at beholding subjects borrowed from the mythology and legends of modern as well as ancient Rome placed upon much the same footing, as mere objects of virtú; whereas it might seem to partake as much of profaneness as the reverse, were an artist commissioned to decorate a luxurious modern drawing-room with Scriptural pieces. Let them be what they might, hardly could they fail, if noticed at all, to strike as most incongruous subjects where the tone of everything else is so diametrically opposed to them, and where the frivolous gossip or the fashionable scandal of the day is retailed as conversation. The feelings—or if such be deemed the more suitable term—the prejudices that restrain us from employing painting to embellish the house of prayer and devotion with scenes drawn from holy writ, ought likewise to withhold us from making such subjects the ornaments of our dwellings, thereby depriving them of their solemnity, and rendering them familiar objects which, if not utterly indifferent, must frequently be felt to be most inopportune. So far, therefore, we are at least somewhat consistent in affording no encouragement, either public or private, to that branch of the art which the Romish church has especially patronized. Which being the case, it is not at all surprising if the talent that should be exerted upon it is turned aside into other channels; far more wonderful would it be, if artists were to devote themselves out of sheer enthusiasm to that cultivation and exercise of their energies, which would lead them to poverty, if not to absolute starvation.

Do what we may, so long as painting shall continue to be dissociated from the intercourse of public life—from both the civil and the religious institutions of the community, it is idle to expect it should ever be again re-instated in the imposing majesty it possessed when the art was intimately allied with religious creeds and popular sympathies. It may continue to appeal to the *taste* of the few, but cannot be made to engage the *feelings* of the many, although it may catch their transient attention. The consciousness of this depresses the artist, and deadens all those loftier impulses which should animate him; for he knows that were he to succeed in subjects of the class alluded to, they would be regarded as little better than happy counterfeits and semblances of bygone traditions of art—things to be criticised by rule, instead of being contemplated with the same spirit as that in which they were conceived.

After all, however, it may be asked on the other side, is there not little—or, more than a little, a prodigious deal—of cant about the efficacy and value of art as a means of moral instruction?* Now, to speak honestly, we confess that such appears to be, to us, the case a there is a great deal of cant, of well-meant exaggeration, of overstrained affection, of blind partiality shutting its eyes to all sober, disagreeable truths. The example of ancient Greece is almost sure to be quoted on every occasion of the kind: yet what did art effect there? it merely softened and refined manners, without purifying morals, being in itself sensual, and often grossly so—to such a degree, in fact, that it might be supposed to have been intended to countenance human vice by examples of deified profligacy—to sanction depravity, and invest the most shocking turpitude with alluring elegance conferred upon it by a master hand. If we turn to art during its palmy state in more modern times, our scepticism as to the efficacy claimed for it is not greatly diminished, when we observe the not particularly laudable versatility of talent with which subjects the very antipodes of each other in sentiment have been treated with equal *gusto* by some of the first masters—those who have obtained credit for having been almost inspired in many of their sacred compositions. Their sympathies seem to have been so truly *Catholic*, that nothing came amiss to their pencils. A Venus or a Virgin, a Magdalen or a Messalina, the seven sacraments or a lewd bacchanalian revel, have been treated by them with apparently the very same relish and sincerity of feeling. He who worked one day for the church and the devout, attempting themes celestial, glorified saints, and the supernal paradise itself with its angelic hosts, could, the next, work, nothing loth, for the carnal-minded and profane, and depict, with far more of nature than decorum, the libidinous amours of the heathen Olympians. The fact itself is indisputable; but then have we not acted unadvisedly, in calling attention to what seems fatal to our own side of the argument—that is, supposing our real intention be to advocate the introduction of painting into our own churches?

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* We have heard that Cornelius the celebrated German artist is to be invited over to this country, for the purpose of painting in fresco some of the halls and public rooms in the New Houses of Parliament. Yet such report may be merely an *on-dit*; at all events, several years must elapse before the building is so far advanced towards completion as to admit of anything of the kind being commenced.

* Of the moral and intellectual influence of the fine arts, we once received a practical lesson that has not been thrown away upon us. It was at a public dinner of artists and amateurs, where in due course were served up sundry fair spoken speeches relative to the importance and moral value of painting and the fine arts generally, which, though they might seem germane to the occasion, we could not help thinking were somewhat superfluous and impertinent, it being likelier than not that the company present hardly required to be told that "there's nothing like leather." But now comes the real moral of our anecdote:—no sooner had the chairman vacated his seat to his "*Vice*," than one of the company being called upon to oblige the rest by the exercise of his vocal powers and gift of "harmony divine," roared forth a bawdy song, no less intolerably stupid than disgusting!

Most certainly we should have kept such awkward and disagreeable events, by urging only what would show it to be of paramount and all truth out of sight, did we either only seek to recommend painting at unimpeachable excellence, or else imagine what we have thus frankly stated to be in itself a fatal and insurmountable objection. Now, we do not hold, as many others appear to do, that there is any abstract unconditional merit either in painting, poetry, or any other of the fine arts, let the talent—or, if it pleases better, the genius—exerted upon them be how excellent soever in itself. It is not the *power* actually manifested, but the *aim* to which they are directed, that renders literature and art a blessing or a curse and pestilence to society, accordingly as they bring with them "airs from heaven, or blasts from hell." We neither claim nor recognise for them any prerogative divine; so very far from it, that we abhor the cant which endeavours to do both. We do not see, therefore, how the laudable use of art can be made to justify the abuse of it, or how its perversion can fairly be employed as an argument against the application of it to a meritorious purpose. Neither are we of opinion that Protestantism is so utterly irreconcilable with painting, as to be unable to avail itself of it without in some degree compromising its principles and character. On the contrary, it appears to us that it would in one respect be more favourable to art than even Roman Catholicism, inasmuch as it would confine it to its legitimate sphere—that of illustrating events recorded in Scripture; and would prohibit all those offensive extravagances which, in Catholic countries, the pencil has been allowed to indulge in, such as representations of the Deity himself, and spiritual and invisible existences on the one hand, and insipid groups of the Virgin and favourite patron saints, together with traditionary legends and similar fancies, on the other. Nothing can be more shockingly irreverent, yet absurdly puerile withal, than the anthropomorphism which presumes to image forth the First Person of the Trinity under a figure and countenance bearing more than an accidental resemblance to the personification of the supreme Jove, the father of the gods, by the ancient sculptors. The Protestant church, again, recognizes no female divinities, nor any of those other divine personages to whom the polytheism of modern Rome has erected altars; its artists would, therefore, be in no danger whatever of following too closely in the footsteps of Catholic painters. Whether or not they would, in consequence, be prohibited from approaching subjects which, partaking as they do of the fancies and fictions of a semi-paganism, afford a freer scope for the imagination and for the pencil than the mere records of Holy Writ, so that it would be disadvantageously fettered down to literal truths, is what we leave others to decide; only remarking, that if fiction be essential to the poetry of art, the Romish church possesses that element of poetry and artistical inspiration more abundantly than its followers will care to allow.

Let the pencil be strictly confined to such subjects as are supplied by the historic records of the sacred writings, nor presume to reveal to mortal eye the visions of a world to come—mysteries beyond the faculties of finite beings to conceive—even to adumbrate in the most inspired flights of poetry, much less to shape and body forth tangibly to the sense of vision. We strongly protest against such awful impieties of art as are some "Last Judgments," even though as works of the pencil they may seem almost superhuman achievements. Considered calmly yet seriously, what are the most miraculous productions of the kind, other than splendid absurdities, gorgeous incongruities, sublime puerilities; in a word, the extravagance and the impotence of art? Let their æsthetic worth be ever so great, representations of that kind must in themselves be mere *conceits*, because that is attempted to be visibly embodied which in itself utterly surpasses conception; accordingly, except as performances of art, they are not superior to the vulgar, rude, bugbear pictures of purgatory so common in Roman Catholic countries. But if the reader cares to be further edified on this topic, let him peruse George Forster's criticism on Rubens' celebrated Last Judgment at Dusseldorff.

There is no danger of our adopting such solemn extravagancies of the pencil; but there most unquestionably is not only a strong prejudice against countenancing painting in our churches, but it seems to be assumed that, even were we disposed to do so, the spirit of Protestantism itself is so uncongenial to that warmth of rapturous fancy, without which the artist can neither worthily conceive nor finish up his conceptions of subjects which ought to awaken corresponding emotions of reverence in the spectator, that all patronage and encouragement would prove totally unavailing—would be attended with no other effect than that of furnishing employment to painters and colour-manufacturers. It is far more easy to make similar assertions than to disprove them, for the simple reason that no opportunity has been afforded of putting them to the test, by any practical effort to demonstrate their futility by proving the contrary. *Fac periculum* would, therefore, be our advice. Yet when Reynolds and many of the Academicians of that day offered to the Dean and Chapter to decorate St. Paul's with paintings gratuitously, the scheme was frustrated by the opposition of the then Bishop of London, who refused his consent on the grounds that it would be introducing Popery into the metropolitan cathedral, or rather, we presume, out of the apprehension of its being so construed by others. It is not every Protestant clergyman, however, who entertains the same scruples, for among Dr. Vicesimus Knox's Essays there is one which warmly recommends the adornment of churches with paintings, as being at all events harmless and unobjectionable, and likely to be sometimes efficaciously impressive. If, indeed, it can be shown that, so far from tending to promote devotional feeling in any degree, pictures in churches would be calculated to produce a contrary effect, the repugnance to them would be rational and laudable. But to reject merely because the Romish church adopts them, seems to us to savour quite as much of indiscretion as of sound policy; since by laying too great stress upon what is utterly matter of indifference as far as concerns the principles of the two churches, we elevate it into a sort of virtual distinction, if which were repealed, there would be danger of Protestantism and Popery being confounded together. Surely the irreconcilability of their respective doctrines and tenets might suffice to remove all apprehensions of such nature; moreover an argument on the other side might with equal propriety be founded in favour of painting, inasmuch as the introduction of it would serve as an additional distinction between the Established church and all the sects who dissent from it. Almost might it be imagined that painting was the very badge and livery of Rome—the mark of the Beast—from whom it behoves us to keep aloof; whereas in truth it is neither essential to Popery, nor at variance with Protestantism. Were St. Paul's adorned with Scriptural subjects filling up those compartments which its great architect contemplated as being one day so occupied, it would not on that account partake one whit more of Romanism than its dome actually does at present, or than its Corinthian columns do of Pagan mythology and the religion of the Greeks. Nay, both those architectural features of the edifice and the style generally might, on such grounds, be considered equally exceptionable, as reminding us too forcibly of the Roman Catholic temples of Italy; while it at the same time becomes doubtful whether there be not some impropriety—some abatement of the wholesome horror of Popery—in permitting ourselves to revert—to relapse into our ancient ecclesiastical style, which flourished here when this country submitted to the spiritual jurisdiction of the Vatican. Mr. Welby Pugin—no mean authority, perhaps, on such a point—considers Gothic architecture and Roman Catholicism to be so intimately connected together, that the former cannot possibly thrive—indeed, hardly maintain itself at all—apart from the protection and influence of the other; yet, so far from entertaining any disquieting scruples against it, we have of late professed ourselves practical admirers of our own indigenous Roman Catholic style of building for new churches and chapels, endeavouring to copy its models as closely as circumstances would permit. Were any *anti-Gothic* critic or dilettante so disposed, he might make use of this last-mentioned fact, and earnestly deprecate such return to the "barbarous monkish style" of our ancestors, not merely as a backsliding in taste alone, but as betraying a dangerous leaning towards the church whose erroneous doctrines we have repudiated; a tendency which it behoves us particularly to guard against just now, when Popery we are assured is gaining ground in this country, and certainly does seem to be putting forth its strength—its attractions and seductions, in the costly edifices it is erecting in various districts of England. For ourselves, we look upon its efforts of this kind without apprehension, considering the alarm attempted to be excited against them to be a mere bugbear, little better than the watchword of a party.

No; we certainly do not wish to approach at all towards Romanism, neither do we consider that throwing open our churches for the admission of paintings by Protestant artists would be an approach to it, any more than walking from Westminster to Highgate can be called approximating to the North Pole. Still, it does not follow that, independently of a seeming tendency to Popery, there may not be objections against paintings, on other grounds—as beneath the dignity of a spiritual worship; as withdrawing attention from the word to visible objects; as adventitious aids which true devotion does not require. Certain, however, it is that, exclusively spiritual as may be the religion they profess, the mass of mankind are unable to abstract themselves entirely from external impressions, but feel an increased degree of awe and devoutness in proportion as religion is allowed to display external majesty and solemnity; whereas the bareness which characterizes most of our churches, does not look altogether so much like simplicity as like penuriousness, begrudging to the house of God that degree of becoming adornment which we bestow upon our own homes.[*] Besides, if objected to upon principle, all decoration of the kind ought to be consistently excluded; which certainly is not the case, because painting is frequently admitted for altar-pieces—nay, there are instances of the works of Catholic painters being so introduced, without any exception being taken to them as opening the door to Popery. Nor have we only pictures of that kind, but painted windows, exhibiting the livery of Popery in figures of legendary saints, or else displaying heraldic emblazonments—the pride of the creature, in temples raised to the Creator. Nay, we will not be quite sure that, if paintings of Scriptural subjects are to be prohibited, we ought not to be scandalized at beholding Westminster Abbey and St. Paul's each converted into a sort of lay Pantheon, and filled with monuments to men illustrious not as exemplars of Christian virtue and piety—as faithful servants and champions of the church—but for secular services performed to the state and the community. Dramatists, actors, artists, poets, musicians, *hoc genus omne*, together with a host of naval and military characters, sufficient to form a United Service Club,—such are the personages who are admitted to posthumous honours in our religious edifices, after undergoing a sort of Protestant canonization from the public. While both the author of the Beggars' Opera and the author of the steam engine have obtained such distinction within Westminster Abbey, without its being considered any profanation to the sanctity of the place, in vain do we look there for any testimonial of national respect to talent and piety, in the persons of such individuals as Milton, Cowper, and Hannah More.

As regards the possibility, however, of enlisting the arts in the service of religious worship, we are of opinion that were the inclination to do so to be manifested on the part of the church itself, many private individuals would contribute towards such purpose, and as the taste so fostered spread itself, others would be stimulated to emulate their example; whereas at present all feeling of the kind is totally discouraged among Protestants, and although a man may erect a church or chapel at his own cost, he cannot contribute towards the embellishment of one by a painting or other decoration, so that by various similar donations and acts of munificence, a religious edifice might eventually be completed in all its embellishments. In fact, we seem to have now no idea of gradually perfecting a structure of the kind in all its parts, but what cannot be accomplished at first out of the original funds is never afterwards attempted to be effected at all; one serious ill consequence of which is that the designs for our modern churches are never made with reference to any after-growth of ornament, or any subsequent finishing up of what has been in the first instance only provisorily schemed. Hence the designs are cramped and stunted in their very conception, and are impressed with a littleness and meanness which, even were it applied, no after study or polishing up can obliterate. Such was not the system by which those glorious fabrics of Catholic times were achieved. Unlike the vulgarly spruce mushroom churches and chapels of the present day, they were generally the matured growth of generations, if not of centuries; and embellishment continued to be added as the means for doing so were afforded, until they became what we now behold them. But, as we have already hinted, almost any building that will afford sufficient accommodation for a congregation is considered good enough for a church:[*] nothing farther is expected to be supplied, after it is once erected—no farther thought and attention, beyond that of keeping it in necessary repair, bestowed upon it.

Almost would it seem that Protestantism made a merit of discouraging architecture, as well as not encouraging painting; for undeniable it is that by far the greater proportion of the numerous churches erected of late years are anything but satisfactory in design, in many cases totally the reverse, and that not entirely because the funds have been insufficient, but on account of the excessive littleness and paltriness that stamp every part of the buildings. The primary consideration seems to have been to provide at all events one or two routine features, whether any other part can be made to accord with them or not. If the style is to come under the denomination of Grecian or Roman, a common-place erection of four or more columns, concocted according to the usual recipe for making a portico,[†] and which the junior clerk in his office can draw out as well, perhaps better, than the architect himself, is stuck up in front; no matter whether the rest can be made to correspond in any degree with the style attempted, or indeed whether it can be afforded to let the entablature be of a piece with the columns. Or if Gothic be preferred, we are generally treated with naked and mullionless pointed windows, in what professes to be the earliest mode of that style, but which in fact is rendered utterly dissimilar in character—as pert as it is paltry. Even where some parts are really good in themselves, there are almost invariably some glaring blemishes to neutralize their effect, and to render the ensemble preposterous and offensive. Vain is it to look for attention to unity of character, and consistency of expression throughout, where there has evidently been no feeling brought to the task, and where the architect himself has not brought forward a single idea followed out *con amore;* but appears to have been utterly indifferent to aught beyond the mere business and trading part of his occupation, as if his title were to be taken in its literal import, and "Architect" meant no more than chief or master builder contracting for the job.

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[*] Nay, while the average cost of our recently built churches does not amount to more than 3 or £4000, no less a sum than *seventy thousand* has been expended on stables at Windsor Castle, besides we know not how much more on other stables for royalty at the Ascot race-course; for which last there certainly cannot be the plea of necessity—so far from it, that we think a female sovereign and her court might very well be excused from countenancing horse-racing in any shape whatever; downright gambling, and nothing else, being at the bottom of it.

[*] Now and then, indeed, an exception occurs; and as an instance, we may mention the new church at Lee, near Blackheath, which, besides having all the windows filled with stained glass, is consistently finished up throughout, and the interior has the singular advantage of being unencumbered by side galleries. The church now erecting at Streatham by Mr. Wild promises also to be one of superior architectural merit, and of very unusual design, the style partaking of the Italian *Vorgothisch* or Lombardic, with some intermixture of polychromic embellishment. A good deal of coloured decoration will likewise, as we have been informed, be introduced in the interior, and, among the rest, that of ornamental terracotta tiles both for the pavement and for parts of the walls.

[†] Our modern porticos are at the best seldom more than *monoprostyles*, for the explanation of which and several similar terms, and also for a variety of interesting remarks on the subject generally, we refer the reader to the article *Portico* in the Penny Cyclopedia, and in the Journal, vol. iii. p. 389.

Were plainness and simplicity identical qualities, or did the absence of decoration constitute soberness, or were chilling frigidity the same as solemnity, then might our present church architecture fairly challenge that of any other age or nation for its excellence in regard to those merits. Unfortunately for it, such is not the case: in vain do we look for either simplicity or soberness: while as for solemnity or aught approaching it, that is entirely out of the question, although it would seem to be the quality of paramount and indispensable importance. "Among all the new churches I have seen," says Candidus, fasciculus 13 of the second series of his "Note-book," "I have certainly not beheld one possessing internally anything like solemnity in its general effect; on the contrary, differ how much they may as to all other circumstances, they agree as far as the absence of that quality goes. Some are dismal and mean enough; others, if not particularly tasteful, smart enough, just the very places for a fashionable congregation, whom the architect generally takes care to arrange so that they shall make as goodly a show as the audience of a theatre, and be able to reconnoitre each other without obstruction. In fact there is very much more of the playhouse than of the house of prayer in such buildings—nothing calculated to inspire feelings of reverence. Neither does it make much difference what style be employed, since the interior of our modern Gothic churches have no greater air of impressive solemnity than have those in any other style."

Were we ever so much disposed to contradict such opinion, we cannot attempt it, for among all the newly-erected churches we have visited, we do not recollect one that can be quoted as an exception; on the contrary, we have been disagreeably struck by several that strongly corroborate the observations we have copied. Much of the want of solemnity above complained of arises from the cold and raw appearance of the interior generally, owing both to the quantity of light which is insisted upon as indispensable, and the almost total absence of colour, except it be occasionally in columns and a few other parts, in which, so far from tending to produce richness, it chiefly occasions spottiness, and a disagreeable littleness of character. Now whatever objection may exist to painting in the form of pictures, hardly can there be any to it as mere colouring, for the purpose both of giving somewhat of richness and finish to the building, and of sobering and toning down that offensive glare which now prevails unmitigated throughout.* It further appears to us, that beautiful and expressive features as are the windows of our ancient Gothic edifices, filled with bold mullions, rich tracery, reticulated panes, and perhaps coloured glass, shedding a "dim religious light," a mellowing hue, and flickering gleams and shadows around, windows of similar outline lose all their beauty when reduced to mere vacant apertures, as is the case in most of our modern Gothic church specimens, and where such apertures are besides no further apart from each other than they would be if the light were partially obstructed and subdued by mullions and tracery. In the other or Grecian style, windows are not a whit better, in fact operate as a drawback upon the style itself, both internally and externally; which defect is all the less excusable, because, not being characteristic and congenial features belonging to the style itself, nothing would be easier than to get rid of side windows altogether, there being so many various modes of admitting light through the roof and cieling, any one of which might be adopted, according as it would best suit the particular design: and if light is, as has been quaintly observed, "God's eldest daughter," there surely can be no impropriety in allowing it to flow down into a place of religious worship immediately from above. The new church of La Madeleine at Paris is lighted entirely after this manner; and although we cannot refer to a single structure of the same kind in this country, where that mode of lighting it has been adopted, we have several and very well known instances in other buildings of its practical application and success. The hall of the Elgin marbles at the British Museum, most of the offices at the Bank of England, the picture-rooms at the National Gallery, the Pantheon Bazaar, the great room at the Polytechnic Institute, and, indeed, most large apartments intended for public meetings, are now so constructed and lighted, although so very differently that hardly any two examples will be found precisely alike. Putting Gothic architecture out of the question—for there, except by perforating the tracery of a vaulted roof, the nearest approach to this mode of lighting from above would be by clerestory windows forming a lantern over the body of the church—putting, we say, that out of the question, there is nothing which is so favourable to architectural display and picturesque effect in the interior of a building as the streaming in of light from above diffusing itself beautifully in a single volume, instead of forming as many distinct spots as there are windows. It is precisely in the magical effect thus produced that the charm of the Pantheon at Rome, as an architectural picture, consists; and yet strange to say, with all their professed admiration of that building, none of our architects have adopted for any of our churches the idea it so plainly holds out.

In fact, it is only by getting rid of side windows, that adequate spaces for paintings on the walls could be obtained in our English churches, should the time ever arrive when, relieved from our bugbear apprehensions of Popery, we should deem it rather a mark of respect than a profanation to array our temples with storied representations of

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* A recent article on new churches in the British Critic contains some exceedingly judicious architectural observations relative to that spurious early Gothic, with lancet windows, or rather mere holes in the wall, which is now so greatly in vogue with the cheap church-builders of the day. In a previous paper on the same subject in that periodical, there occurs likewise a suggestion which, should it ever be acted upon, would tend materially to improve the architectural character of our Protestant churches, namely, that there should be not a mere shallow and confined lobby, as at present, but a spacious vestibule or pronaos between the entrance from the street and the body of the church itself. "There should be something to create the idea of retirement, and distance from the public thoroughfare, like the ante-chapels of our colleges." The circular part of the Temple church is mentioned as furnishing a hint for the purpose; and a very recent application of such sort of pronaos may be found in the elegant chapel of St. Mark's, North Audley-street, which, if merely on account of that circumstance in its plan, deserves especial notice among contemporary structures of the same class in the metropolis. A vestibule of this kind, it is further observed, "might be always open during the day, as Guildhall is, without inconvenience; and it might be the place for sepulchral monuments, and for other memorials and inscriptions of a not entirely secular character." We will add, it might be the place too for paintings of Scriptural subjects; but then, unfortunately, we have no notion in this country of monuments and pictures being exposed to the view of those who cannot afford to pay for seeing them as sights; but they must be as rigorously excluded from the gaze of the profane and vulgar, as if there was danger of the taste of the lower classes being degraded and their morals corrupted by contemplating such works of art.

* Be the objections made against pictures in churches, as partaking too much of Popery, well or ill founded, they certainly need not prevent our adopting a nobler, or rather a less mean and impoverished style for the edifices themselves, very few of which, among those lately erected, are at all decently adorned, even as Protestant places of worship; because there is certainly no danger whatever of their being made to resemble those adapted to the Romish service. At present almost anything like architectural effect is entirely out of the question; and the galleries are frequently suffered to occasion if not exactly a theatrical, a very playhouse-like look. For the management of those somewhat unmanageable and refractory parts, and also for the general disposition and mode of fitting up the interior, we would refer to a structure which, if not Protestant, is incontestibly not a Catholic one, namely, the new synagogue in Great St. Helen's, Bishopgate-street; which, without being at all over-decorated, in some respects rather less so than we could wish, is a handsome and elegant piece of internal architecture, and might be studied with some advantage by our modern church-builders, unless indeed, our delicate scruples should reject anything from such a source, as being likely to lead us to Judaism.

Scriptural subjects—innocent as embellishments—possibly more or less efficacious as impressive lessons, and aids to devotional feeling. At present there is hardly a church, except St. Paul's, calculated for the reception of wall-paintings, yet of such decoration even that, we find, has been deprived, through the over-scrupulousness of one who could enforce his *veto* against it; and perhaps, were it not that they are utterly lost in obscurity, the same worthy prelate would have condemned Sir James Thornhill's paintings in the cupola to be expunged by whitewash. The exterior itself of the cathedral might at the present day be objected to by some, as presenting in its noble dome, its statues, and other ornaments, more of a Papistical physiognomy than is becoming in a Protestant church of any kind.

There is, we suspect, no small degree of superstition, or else regard to the superstitious fancies of others, in that excessive and over-zealous avoidance of things perfectly indifferent in themselves, merely because they have been used—perhaps greatly abused—by the followers of a different creed. But is not this apparent virtue a fault, and that by no means a light one, partaking as it does of that haughty and uncharitable spleen, which our Lord himself omitted no opportunity of reproving in the Pharisees, against whom, as has been remarked by a certain writer, all meek and humble as he was, he was continually directing the severest sarcasms and the most pointed irony.

That we may allay the fears and scruples of those who in their just aversion to Popery look upon painting and sculpture in churches as part and parcel of it—as among its enticements and defilements—we will now listen to Dr. Grüneisen, whom, to say the truth, we have kept in the background so long, that our readers may have begun to suppose we did not intend to admit him further than the threshold of our article. Now, as is evident from the title he has given it, the scope of the Doctor's dissertation—which, we may observe, appeared on the occasion of the Reformation festival at Leipzig, 1839—is to show that the principles of the Reformation do not demand the renunciation of the fine arts, or their expulsion from the service of the church; and that it is a mere vulgar prejudice to imagine that the reformers themselves either desired or contemplated any such result, but merely sought to abolish those idolatrous pictures and statues to which the Romanists ascribed supernatural efficacy or particular sacredness, together with relics—always doubtful, and for the greater part, merely fictitious. The indiscriminate *Bilderstürmerci* and spoliation of works of art in churches and religious houses proceeded entirely from the lawless fanaticism of the people, who, in all sudden changes, whether political or religious, think they cannot better display their sincerity in favour of one cause, than by blindly attacking and wreaking their vengeance upon whatever is considered by them identified with that of their opponents. So far, however, were the heads of the Reformation from sanctioning or any way countenancing this zealot Vandalism—albeit some Protestants of the present day would perhaps show themselves less scrupulous and less moderate—that they exerted their authority and influence to arrest the mischievous havoc, as far as was then possible, even at the risk of offending their own intemperate partisans. To look upon them, therefore, as the instigators and abettors is a calumnious error: with far more truth and reason may the Romish church be charged with directly sanctioning those idolatrous superstitions and practices among its followers which it affects to disown for itself; inasmuch as it has tacitly connived at and profited by them, without lifting up its voice against such enormities.

Zuinglius expressly says, "statuas, imagines, et simulacra, nemo tam *stolidus* est, qui putet abolendas esse, ubi nullus eis cultus exhibetur"; and although he remonstrates against the papistical use or abuse of such representations, "alioquin," he adds, "nemo magis miratur picturas, statuas, et imagines quam nos." Very few will attribute much laxity, or indeed any want of rigour to Calvin, and yet we find this stern reformer speaking with a liberality in favour of art that is little less than startling: "neque tamen *eâ superstitione* tenear, ut nullas prorsus imagines ferendas censeam. Sed quia sculptura et pictura *dona sunt Dei*, purum et legitimum utriusque usum requiro, ne quæ Dominus in suam gloriam et bonum nostrum nobis contulit, ea non tantum polluantur præpostero abusu, sed in nostram quoque perniciem convertantur." Here he openly vindicates the employment of both painting and sculpture in the service of the church, and for the adornment of its temples, calling them gifts from God, and making use of the very strong and remarkable expression, "neque eâ superstitione tenear," which may be interpreted "I have not such a blind and superstitious horror of the superstitions of popery as to imagine that all pictures ought to be interdicted." Indeed, he elsewhere recommends the introduction of historical subjects from scripture as silent admonitions, and incentives to godliness. In short, we believe that the Royal Academicians would have succeeded far better with John Calvin than they did with the Bishop of London, who, when they applied to him, certainly evinced some of that *superstition* which the celebrated reformer disowned. Yet, as we are not Calvinists, and therefore his authority may have comparatively little weight, let us turn to Luther, whose opinion ought certainly to stand for something; and, undoubtedly to the surprise of many, we find him taunting the *Bilderstürmers* or iconoclasts, and destroyers of church pictures and images, with tolerating similar representations in the wood-cuts of their German bibles. "I humbly crave, therefore," he adds, "that they would allow the same license to us, and permit us to adorn our walls in like manner as they do their books, with images forcibly calling to mind, or else serving to explain, what is recorded in Holy Writ; because I see not how they can be more hurtful when delineated *upon a wall, than on the page of a book*. Would to God I might persuade our great and wealthy ones to have the entire bible painted both outside and withinside their houses; that would be truly a Christian work." Without exactly assenting to this last opinion, which appears to us of very questionable propriety, we may be satisfied with the direct and explicit testimony given in favour of painting and sculpture as suitable adornments for churches, by those who, as Anti-romanists, are generally supposed to have viewed them with abhorrence, and to have laboured to suppress them.

The other fallacy or error here combated is the prevalent idea that, independently of the change in religious worship, the Reformation has proved of evil influence upon art generally, there being, in the very constitution of Protestantism, what checks and prevents art from coming to full maturity, although it may not actually blight it in the bud. We grant that no second Raphael or Michel Agnolo has arisen as a luminary of Protestant art, that painting has upon the whole declined since the period immediately preceding the Reformation; and had such declension been confined to those countries which embraced the reformed faith, the argument sought so to be established might be received as a valid one; whereas the case stands altogether differently, since it is precisely in Catholic and papal Italy itself that the fine arts, and painting more especially, sunk almost to degradation—to mere mechanical and tasteless routine—to insipidity and almost to imbecility, during a considerable portion of the two last centuries, although it would seem that if Catholicism and Protestantism had any share in the matter, it ought to have received a fresh impetus in Italy, from the roused spirit of rivalry, and the desire of opposing the majestic array of Catholic worship in all its splendour, to the tasteless and cheerless poverty of that of the reformed church. Allowing, therefore, that it was their religious faith and the æsthetic influence of their creed which, animating the great Catholic artists of other days, and enabled them to achieve works that seem almost to have been inspired, we must conclude that the prompting, devotional spirit of their creed has long since passed away, and that Romanism itself is now little more than nominal, compared with what it formerly was. Either the cause alleged was not the real one—or at best, but one concurring with many others, or it has now ceased, since it most evidently is no longer in operation. On the other hand, Romanism favours a good deal that is most anti-æsthetic, and attaches a high value to many things that art would repudiate, either as absolute deformities, or as vain baubles and gewgaws. What shall we say of that pious taste for bijouterie which the Romanists practically attribute to their saints?—of diamond necklaces and other trinkets, childishly dedicated to the Madonna? "The pomp exhibited in architecture and painting," says the author of 'Records of a Route, &c.' "is intelligible enough; not so that which consists in treasures hoarded up in cases, which do not contribute even to make any show in the way of the furniture of a church, as is the case with magnificent candelabra and other utensils. Treasures of that kind are fitter for a goldsmith's or jeweller's shop, or for the toilette of a fine lady, than as offerings to a saint." In regard to relics—but no! there is no occasion for our making any comment upon them, they being of themselves calculated to do eminent disservice now to the cause of Romanism, by exciting contempt and ridicule against it.

The second work whose title is prefixed to our article is by a minister of the reformed church in Switzerland, but who nevertheless advocates some relaxation of that austerity which has hitherto characterised the religious community to which he belongs, and given a repulsive coldness to social worship, the reverse of alluring. The ascetic renunciation, he observes, of all that partakes of æsthetic feeling—of all that ministers to refined, intellectualized enjoyment—demands a degree of spiritual perfection that falls to the lot of few; while to the many, it only renders what ought to be devotion a frigid and formal penance. And indeed the exaggerated rant of the conventicle seems to be almost necessarily resorted to, by way of equivalent, for producing that excitement which the religious pageants of the Romish church supply. Both extremes have one aim in common, and both partake of acting for the sake of effect, though the means resorted to for producing it appear so contradictory.

Contenting himself with cautioning against abuses, the anonymous writer last referred to expressly recommends that the church should be allowed to enlist the fine arts in its service. Neither is he by any means singular in his views, for both the Lutheran and the Calvinistic churches in Germany have of late begun to relax their former strictness in that respect; and that reaction seems now to be taking place for which the public were prepared by the official announcement of the Prussian minister Von Schuckmann, in 1814, wherein it was signified that it behoved the church "to give greater solemnity to the form of religious worship, inasmuch as that at present adhered to does not at all address itself to the feelings, nor is sufficiently impressive."

How far the same remark applies to the service of the church of England, we pretend not to judge; yet certain it is that a great majority of our churches, including those of some of the wealthiest parishes, are barely decent, and no more, in their fitting up—not squalid, indeed, but stamped by such begrudging penuriousness, as to betoken anything but excess of zeal. Nor can we attribute this either to the rigid ascetic notions of the age, or the poverty of the country; for the age is liberally indulgent enough, and of wealth there is also enough, but the spirit of the age is selfishness—cold, calculating selfishness. At the same time, it must be allowed that the church itself has rather repelled than invited private munificence to contribute towards the adornment of its temples and its service. However, we will not quarrel with such a state of things, even for the sake of upholding the cause of art, towards which our affections yearn. Yet, while we make such concession, we expect some also in return, and, therefore, claim that Protestantism should not be made to bear the odium of condemning us to shut the doors of our churches against works of art. If we either cannot afford, or do not think it worth while to obtain them, we are perfectly satisfied with either of those honest and very intelligible reasons: it is our pockets, not our Protestantism, that suggest our sensitive scruples. As to scruples of any other sort, they are all make-believe. There is not the slightest danger whatever of pictures tempting us to relapse into Popery, or gaining us over to its monkish charlatanry, its polytheism, and its miracle-mongers. We are just as likely to become converts to a belief in witchcraft, as to Romish idolatry. The taste of the age in osteology is for bones of megatheriums, not for those of Saints. Why then so much affected alarm? Between the doctrines of Romanism and those of Protestantism the gulf is so wide that art can never bridge it over; and, of the two, Romanism is infinitely more in danger than Protestantism, for the simple reason that is stated by the Italians themselves, in a proverb that cuts their own creed most keenly—"Con L'EVANGELIO si diventa ERETICO!" Yes, the Gospel is, after all, the great and never-failing source of heresy—of that most awful heresy which alienates men from the craftily-devised chimeras, and the simulated Christianity of Rome.

ON GRECIAN ARCHITECTURE—ITS BEAUTIES, AND THE DANGER ATTENDING THE IMITATION OF THE STYLE IN MODERN TIMES.

To point out in what consist the qualities of beauty, and to make one kind of definition universally applicable, is an all but impossible matter in any case, and is especially difficult in all that relates to architecture. By Mr. Alison it has been ably argued "that in every subject that form, whether angular or curvilinear, which is most expressive of these qualities (viz. fineness, delicacy, or ease,) is the most beautiful form." We find little to oppose in that part of his essay which treats of colours and sounds; but on the source of the emotion in forms, and more especially in architecture, he fails. His fundamental principle is that "matter is not beautiful in itself, but derives its beauty from the expression of mind," (Essay on the Nature and Principles of Taste) and he instances the triumphal arch, and the temple in its primitive state, as beautiful objects, so considered, only from the perceptions of grandeur and solemnity, which they are calculated to awaken. But surely he too hastily *assumes* them to be beautiful, for few modern architects can see in the triumphal arch great beauty of form; and we might adduce many examples of temples, by which the emotion would not be excited, solely from their wanting those decorative features essential to its production. Mr. Alison proves, which it was scarcely required to do, that certain feelings are excited by the sight of the triumphal arch, of the undecorated temple, of the hearse, and of the engines of war; but we cannot but hold, that he errs in considering those to be emotions of beauty, for we most carefully discriminate between THE BEAUTIFUL, and what is merely the sumptuous, the reverential, the solemn, or the terrible, each of which may powerfully influence the mind, without at the same time being any proof that beauty exists, or can be perceived, in the object. An edifice may possess no one feature which an artist would call beautiful, and yet produce the very feelings of which Mr. Alison speaks. The uneducated, in standing before a large and costly edifice, may be heard to express extravagant admiration, but it is alike with them whether the design be excellent or not; they lavish the terms "grand" "imposing" upon structures possessing no one merit, because they excite in them wonder, mistaken for an emotion of beauty.—Another current opinion, which is at war with true principles of taste, is, that *any* building of stone is better than one of brick, whatever the design. If it be true, that the ordinary forms of the vegetable world possess as great beauty as the costly exotics of the conservatory;—if it was from the oak leaf, from the parsley, and the cabbage, that Gothic architects most loved to mould the graceful foliage of their capitals and bosses;—we ought from them to learn the true value of what happens to be common, and easy of attainment. Of what may be done in brick and stone, whether in the Gothic or the Italian style, the earlier and later portions of Hampton Court palace bear sufficient witness. The evidence of durability is as high in favour of brick as of stone.—But, whether we entirely concur in the opinions of Mr. Alison, or not, it must be granted, that much of our admiration of Grecian architecture must be ascribed to associations connected with the days of Phidias and Pericles, of the splendour which shone round all the arts, where, "on the Egæan shore," stood the temples of Minerva and Theseus, and where poetry, philosophy, and the arts, combined to render "the violet queen" the centre of an ever-spreading halo, undimmed through all succeeding time. Who, that loves art, poetry, philosophy, liberty, does not feel his soul expanded and elevated at the name of Athens? what artist, at the sight of Grecian architecture, does not think of the mind that conceived, and the people that appreciated? These are associations even more potent than any—as Mr. Alison might say—of lines and angles with strength and utility, and of curves and enrichments with elegance and grace.

In the moving and breathing figures of the procession in the Parthenon, and in the rich adornments of the Choragic monument, we are reminded of the "earth-born" people, who hurled back the invaders from the fields of Marathon and Platææ, and who hailed the works of Æschylus and Sophocles victorious in the theatre. Not that the intrinsic beauties of Grecian architecture are non-existent or unworthy of notice, but rather, that great as they are, they are subdued by the larger influence of intellectual association. The native beauty is beheld, in the perfect adaptation to the two ends of elegance and strength, so that the proportion, which exhibits the greatest degree of elegance, is precisely that which also resulted from the arrangementmost conducive to the stability of the work. By placing the columns at short intervals, an intricate and shadowy effect was produced, at the same time that the stones of the architrave were just sufficient to support the weight of the frieze and cornice above. Further to lessen the bearing of these stones, the upper part of the column was extended, and became the capital. To improve the outline of the mass, and to throw off the water, the sides of the roof were inclined from the centre, and were formed in parallel lines down to the projecting cornice.

The theory to which we have adverted was first broached by Lebrun (*Théorie de l'Architecture Grecque et Romaine*), and has been proved by Mr. Gwilt to be by no means fanciful. In five examples of celebrated edifices, "the superficies of the columns, cut through their axes vertically by a plane parallel to the front of the building, are compared with the area of the entablature and pediment of each respectively. The weights of each being as the cubes of the square roots of the areas, these areas will equally represent the supports and weights in either of the terms.

In the Parthenon, the supports are to the weights as	1546 : 1843 or 1 : 1·19
But if the steps be reckoned, the ratio will be as	2183 : 1843 or 1 : 0·84
In the Doric Portico, the supports are to the weights as	4070 : 3990 or 1 : 0·98
In the Pseudo-dipteral temple at Pœstum, the supports are to the weights as	1090 : 1103 or 1 : 1·01
In the temple of Erectheus, as . .	2640 : 2800 or 1 : 1·07
In the Pantheon at Rome, as . .	1566 : 1723 or 1 : 1·10."

(*Gwilt's Chambers' Civil Architecture, note, page* 160.)

Thus we see the impropriety of our monumental columns, which, designed for a proportionate weight of entablature, sustain nothing but a vase or a statue in most sweet communion with larks and crows; which have not even a decorated shaft, to render less striking in each, its resemblance in form, and its contradiction in end, to a column from a Roman portico. The Roman triumphal columns were not facsimiles from one temple or from another; they were not even of any particular order, and their shafts were made the means of exhibiting to posterity a history of the events they were erected to commemorate. Amid the beautiful decorations of the Trajan and Antonine pillars, we forget the impropriety of an isolated column, and look upon them as relics, handing down to us, through the stream of time, the most vivid picture of Roman greatness.

Deeply impressed as we are with the love of Athenian architecture, for its intrinsic beauties, and for the charms with which it is surrounded by association; removed from a land where sunset gilds "with one unclouded blaze of living light," "Egina's rock and Idra's isle;" rather using a portico to shelter from the elements, than to retire from the heat of the sun; it is impossible, that our attenuated copies of the fronts of Grecian temples, can strike us with other feelings than those of disappointment and regret. We have no peristyles hung with garlands and crowded with admiring votaries; our imitation is all but limited to an entrance portico, attached to the middle of a building, wholly different in character, and with which it ought to have no connexion whatever. Our buildings stand in crowded streets, and are splashed with their mud, instead of crowning the "marbled steep" of a promontory, or the summit of an Acropolis. Stories of sashed windows riddle the front, and pots and pipes of every imaginable contortion rise from the roof. No sculpture decorates the metopes or the pediment; no colours glitter in the sun. The wall at the back of the columns seldom recedes, as in the temple of Theseus, and in that on the Ilyssus, neither are there internal columns to produce depth or intricacy. The National Gallery is one of the few buildings of modern times in which these points are attended to, and it does not, therefore, deserve all the censure it has received. In the Royal Institution at Manchester, Mr. Barry has not omitted these all-important features. The greatest fault of the National Gallery is in not placing its portico upon a bold flight of steps, but, instead, upon a podium, a thing never done by the Greeks, and never by the Romans in the main front. We see Grecian buildings—the main lines of which are horizontal—piled one above another to form steeples, whose lines ought to be perpendicular. The Gothic is the only style, capable of modern application, in which the diminishing steeple can with perfect propriety be employed; for however beautiful an outline at a distance may be, a near inspection of details, formed by many horizontal lines, seldom fails to displease. It must, however, be granted, that some of the steeples of Wren are so extremely beautiful in their outline, that we are compelled to pass over their other faults. The least beautiful examples of Athenian buildings are copied with even more fidelity than the temples, the Propylæa, and the monument of Lysicrates; while the victor's wreaths from the Choragic monument of Thrasyllus are employed on the fronts of buildings with which they have no character in common.

But whilst we are making all these objections to the modern imitation of Grecian architecture, it may well be asked—Ought the sublime structures of Greece, and the labours of Revett and Stuart, to have no influence on our style? Undoubtedly they ought. But whilst we have at our disposal the funds of individuals instead of states, and whilst our modern wants require conveniences, which would at once, if introduced, destroy the character and synchronism of a Grecian building, let us not attempt that, which the first step will show is at war with the soundest principle of architectural taste, viz. that all decoration should have its origin in, or show the semblance of, utility. While the Grecian style is quite unfitted, the Italian style is well fitted, to the wants of our climate and manners. It is capable of every variation; it may be used without orders, or may be combined with, and influenced by, the Grecian, without any violent anachronism being apparent. In the style of the Italian palaces, where the orders do not form an important feature in the front, we possess fine examples in the Reform Club House, and in the Manchester Athenæum, both by Mr. Barry. So much has this beautiful style given place to the bad imitation of another unsuited to our wants, that we might suppose our modern architects deemed the presence of a gigantic order, essential to the existence of beauty in a building. Who must not confess, that the most beautiful buildings of Sanmichele, of Vignola, of Palladio, and, in our own country of Chambers, of Burlington, of Talman,* owe an effect to their boldly projecting cornices, to their decorated doors and windows, quite equal to that of the orders, which form so subdued a feature in their fronts? And are not these gazed on with equal delight with the beautiful works of Wren, of Vanbrugh, of Gibbs, and of Hawksmoor, all of whom employed the orders on a large scale, but who used them with more judgment than we have in later times, with all our knowledge of Grecian buildings. But, if the orders are essential, why not, with the classic feeling of the Germans, engraft upon the Grecian a style, which shall be suited to our wants, and yet shall be Greek in feeling and in character—in which we shall recognize no indifferent *copies* of orders and porticos, showing by contrast the presence of parts necessitated by our climate—in which the spirit of a Grecian architect shall appear to pervade the whole, rather than that the orders should appear the work of an artist, and the doors and windows of a mason and a carpenter. And thus we may find the true value of Grecian architecture; learning between it and modern adaptations to choose a style which shall neither offend by its anachronisms, nor subject us to any diminution of our necessary comforts, designing as Greeks would have designed, had their wants been like ours. Our buildings must be Grecian in essence rather than in form.

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* The talented architect of Chatsworth House, Derbyshire.

E. H.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXXVII.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. There is one circumstance attending architecture at the present day, which has not had the attention and consideration given to it, it deserves; for while so much has been said in regard to the merits and the history of different styles, it has scarcely been noticed that we possess no real style of our own. We may adopt, we may borrow, we may revive, those belonging to other countries, or other times; yet that amounts to no more than the transplantation of them, and, unluckily, the process itself seldom turns out to be any better than that of transplanting *dead trees*. However successful particular buildings may be as imitations, the styles themselves do not take root; they exhibit no symptoms of vitality; they do not *grow*; they put forth no fresh branches: on the contrary, the chances are that some of the old ones are lopped off. By this time it might be supposed Grecian architecture would, if capable of striking root at all, have begun to manifest some vigour, yet it thrives no better than a mere sapless trunk. We began by copying it, we continue to copy it, and are not likely to get any further than copying it. We have got our lessons in it by heart, and repeat them by rote; as to getting them by *head*—that is a different matter, and one of which the idea seems to have occurred to no one. We proceed with it just as far as the extant examples of it will carry us, and not a single inch further. Nearly half a century ago we had Doric porticos *after* the Parthenon—*anglicized*, indeed, by sculpture being omitted in the metopes, and if we now want a portico in the Doric style, we still go to the Parthenon, or at least to some other established authority, whose columns are as scrupulously copied as if the modern building were intended to be a perfect fac-simile of the ancient one, though it may be impossible to trace the slightest similarity between them except that attending the columns alone. More frequently, too, than not, these last, so far from contributing to style, only serve to show the mutual incongruity between themselves and all the rest, the portico being as little in harmony with the building as the building is with the portico. This system of servile copying—in any other art it would be reprobated as downright plagiarism and piracy—has absolutely stifled the germs of invention, and checked all originality and artistical feeling, which, instead of being encouraged, are actually deprecated as leading to innovation. What a bugbear word is that same "innovation"! Surely, if authority and precedent be of any value, there is abundance of both to sanction innovation, for what is the history of architecture itself, but that of a series of innovations. Without innovation the Greeks would never have advanced beyond their Doric style, and our own ancestors would have stuck fast at their Norman one: or if introduced at all, never would the pointed style have attained that growth, or spread out into that rich luxuriance it ultimately attained, after passing through various stages of—innovation.

II. Well, now that we have again turned to the lancet or first stage of the pointed style, there is no danger whatever of its shooting out afresh. As lately adopted, it is not an infant style of our own: of the promise of early childhood it possesses nothing, of the hopeless imbecility of second childhood and childishness, much. Are we then to conclude that the inventive powers of architecture are now utterly paralyzed—that as an art it is extinct, and reduced to what is little better than a mechanical profession. The plodders in it are many, those who aspire to be more than plodders, who apply themselves to architecture with the feelings of real artists, are—I will not say how few; but leave it to every one to judge if he himself is among those few in whose favour I throw in that saving clause, lest I myself should be *clawed* and clapperclawed by the whole of them. No one will now cry out; not even Professor Brown, since he will, doubtless, think he must be upon the list of my exceptions.

III. It has been remarked, in regard to despotism, that bad as it may generally be in practice, it is theoretically better than freedom; which doctrine, strange as it may be thought by Englishmen, seems to be that of architects, for they preach in favour of the despotism of authority and of slavish submission to precedents. One of their *oriental* maxims is that what has hitherto served and satisfied those who have gone before us, may very well satisfy us. Of innovation they entertain a most *oriental* horror. Enamoured of slavery, they deprecate artistical freedom, and hug their fetters the more closely when any one proposes to knock them off. Like Russian serfs, they do not care to be emancipated; for they have so long been accustomed to slavery, that to be now released from it would be exceedingly uncomfortable to them. They prefer remaining always in leading strings; since it is far easier to suffer themselves to be so guided, than it would be for them to attempt to guide themselves. Most assuredly it is very far easier to follow *rules* so plain and straightforward that they cannot be missed by any one who is capable of following his own nose, than it is to hunt after and put oneself under the guidance of *principles*—little better than so many will-o'-the-wisp phantoms. Rules, on the contrary, are exceedingly safe, and admirably convenient; they spare a great deal both of time and thought: should you happen to go wrong, the fault lies with them, not with yourself; or rather, as they cannot be otherwise than right, you cannot possibly be wrong. In defiance of every blunder or sin against good taste, you can quote Palladio or some other great authority. There is no architectural vice or absurdity for which some "venerable" and respectable precedent may not be adduced, and if your doings in the Grecian style are reproached for being mawkishly insipid, frigid, common-place, and dull, you can shelter yourself under the very respectable authority of that very classical architect—Smirke.

IV. The more it is examined into, the more untenable will that doctrine be found which refers the origin of the Grecian orders to a timber construction and to the primeval wooden hut. Such notion is absolutely preposterous; not only is it rebutted by the character of the style itself, but is utterly at variance with all historical analogy. The farther we go back into our researches, the more direct evidence do we obtain that the very earliest architectural monuments of all were entirely of *massive stone*, and that so far from resembling even the the trunks of trees, the columns were merely upright monolithic blocks, nearly square throughout, with at first very little indication of circular shaft, except in the upper part, beneath the capital, to which it served as stem. Such is the ancient architecture of India, the earliest of all—ponderous, rude, gigantic, and sublime. Borrowed, though not *copied* by the Egyptians, this style underwent a transformation; it was considerably refined; the columns or supporting blocks were made circular throughout, if not invariably cylindrical. Borrowed in its turn, but not *copied* by the Greeks, the Egyptian style underwent a similar process of transformation, and was moulded into the Doric, the cylindrical form of the columns being changed into a conical or tapering one. Such origin plainly accounts for the proportions—so much prated of, and apparently so little understood—of Grecian architecture; whereas they are not at all to be reconciled with the idea of an original timber construction, originating in the brains of "venerable" old women who have written upon architecture, and received as matter of faith by those who find it much easier to believe any nonsense than to examine and inquire. Would even the most massive timber construction have led to any thing like the proportions that characterise the early Doric order? Certainly not; it would have led to quite a different system, both for the columns and the entire structure. That of the intercolumniation would have been just the reverse of what it now is, for the columns would have been three or four times as wide apart. If a timber construction was the type, the character of that type would have been preserved—at least tolerably kept up—at any rate not entirely obliterated. What analogy is there between a timber construction and the ponderous Doric entablature and the *squareness* which prevails in all its members? Oh! but a timber construction, it will be urged, accounts so very "nicely" for the triglyphs. So, then, in order to account for what is something altogether subordinate, and perhaps almost entirely arbitrary, we are to give up what accounts for and explains the style itself, considered as a whole. After all, too, they are accounted for one way just as well as the other. If intended to represent the horizontal beams laid on the architrave, and forming the ceiling between that and the external roof, it does not follow that those beams were of necessity timber ones at first, since we meet with precisely the same arrangement and forms in the ceilings of the most ancient stone constructions. Being ourselves invariably imitators, we seem to be also of opinion that men must have had *ab initio* some express model or type, and that those who contrive and invent must have some pattern to go by.

V. "An *engineer* 's the noblest work of God"!—staggering as it is, such is the doctrine *literally* put forth in a certain quarter, where it is maintained to be the highest honour of our race to be engineering animals. Sages, poets, artists—how do *you* relish it?—you who have so long arrogated to yourselves the topmost pinnacles of human glory? But the world has been mistaken all along, and henceforth mechanics must take precedence of mind, and machinery of art. Having advanced so far in such ultra-utilitarian doctrine, should we not take another step, and be convinced that man himself is but a mere machine —a piece of clever engineering work. Let us hear no more cant about Grecian or Gothic art—let us have no more extacies on the subject of the Parthenon or York Minster—of the Cartoons or the Elgin marbles—the triumphs of Christian or of Pagan art. Henceforth the bridge-builder is to be looked upon as the *Pontifex* maximus of society; and Homers and Phidiases, Handels and Raphaels, &c., as a very useless race—quite valueless according to the new ultra-utilitarian principles. We need not, however, inveigh against those principles, because there is no danger of their being at all contagious, for their exquisite absurdity renders them perfectly harmless.

PEN AND PENCIL SKETCHES IN POITIERS AND ANGOULÊME: WITH SOME REMARKS ON EARLY ARCHITECTURE.

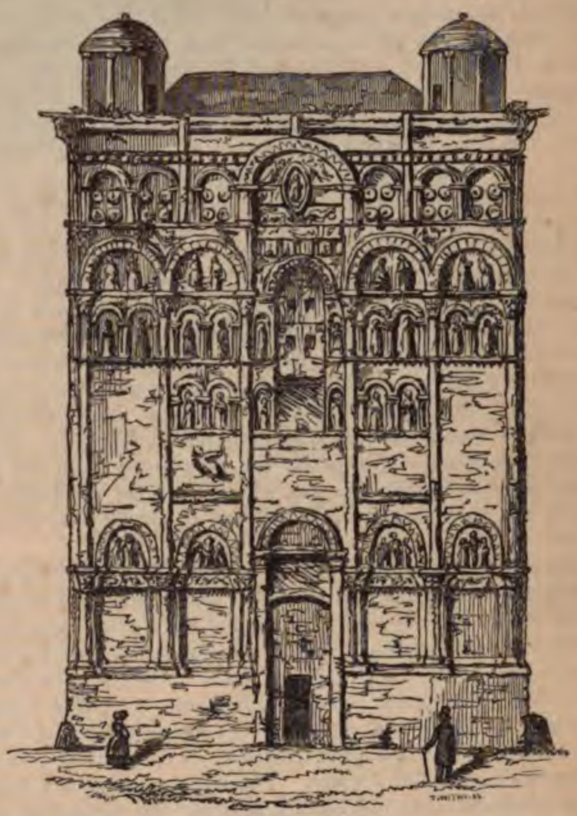
By George Godwin Jun., F.R.S., &c.

(Continued from page 71.)

Chapter 3.

If a tea-cup be reversed in a saucer, it will convey a very clear idea of the regularly formed mountain, on the truncated top of which stands Angoulême, one of the most ancient of French cities. A low wall encloses a public promenade (once the ramparts) around the whole of the flat summit occupied by the houses, and affords some beautiful views of the continuous valley, studded with cottages and sparkling with streams, at the foot of it, as well as of the adjacent picturesque rocks and hills. In consequence of this peculiar and almost inaccessible position, Angoulême was ever regarded as a safe refuge in troubled times; thus, at that period when the Normans, or North men, ravaged France, burning down churches, and destroying all before them, we find the inhabitants of the neighbouring districts constantly flying to this city, and there defending themselves, although not always successfully. The approach to Angoulême from Poitiers, from which town it is distant about 78 miles, is very pretty; the peculiarity of its position, and the smoothly flowing Charente which passes it, lending it additional attractions. In the city itself, the chief object of regard is the Cathedral, dedicated to St. Peter,—a structure so extraordinary in its character, that it should be visited by all who view with interest the various shapes taken by architectural skill in the middle ages, the various modifying circumstances which led to this variety in different localities, or who are seeking to learn the immediate source of the style of cisalpine edifices.

Fig. 7.



The above view of the west front, although sketched on the spot,* and correct in the generalities, gives but a very feeble and inadequate idea of this extraordinary façade. The boldness of the sculptures, the size of the five main arches and columns into which it is divided, and the universal decoration prevailing throughout, produce an effect picturesque and striking in the extreme.

In character it resembles Notre Dâme de Poitiers (see Fig. 4), and is of that transition period when the semi-circular arch was about to give place universally to the pointed. In width it is about 62 feet. The entrance doorway in the centre was spoiled by injudicious repairs in the last century; formerly it seems there was a porch before it composed of three arches.† In the arcade on either side of the door, the heads of which take a slightly pointed form, as at Notre Dâme de Poitiers, and are elaborately sculptured, are the twelve apostles; underneath one of the groups are sculptured knights tilting in chain armour. Above the door is the only window in the façade, now closed, having around it sculptured figures in arcades. Over it, in the centre, is a figure of the Almighty in a *vescica piscis*, supported on a very elegant honeysuckle scroll, and flanked by the symbols of the four evangelists. The intrados of the arch above it, is sculptured to represent eight angels. The upper arcade contains a number of circular medallions, with heads upon them. The cornice which terminates the front, and the small turrets at the angles, seem to have been added at the commencement of the 16th century.

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* In October, 1841.

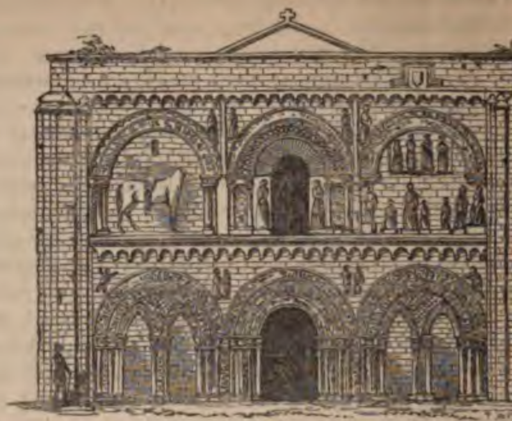
† This was demolished between 1808 and 1810. About the same time, cloisters attached to the building were destroyed.

There is a small octagon tower at the junction of the nave and transepts, but the bell tower is situated at the extremity of the north transept, and is a very remarkable and beautiful specimen. It rises independently to a great height, and is divided into six stories above the transept, adorned with columns and semi-circular arcades, and terminated with a short pyramidal roof. It may be seen many miles round, rising from the conical hill on which the city is placed, like a high mast, and has a very curious effect. With regard to the details of it, the capitals of the columns are leafed, and indented squares, scrolls, &c., are amongst the chief ornaments of the mouldings. In the top story but one, the arcade would seem to be an alteration or addition, other arches appearing behind those on the face. The uppermost story has large circular pillars at the angles. Withinside the church, the nave, which has no columns, is covered by three large *cupolas* with plain horizontal bands between each, passing from wall to wall. The bands form a pointed arch, as they do also on all four sides under the centre tower, which is pierced with openings, and serves as a lantern to light the space between the nave and the choir. The choir, which has an aisle on either side of it, terminates with a semi-circular absis, the whole much modernized and injured. The transepts originally presented similar cupolas to those now in the nave. These cupolas are very singular, and are to be seen only in very few instances in France. M. de Caumont, who examined this cathedral in 1834, considers that originally they formed the external covering, but that, finding it difficult to prevent the infiltration of rain water, a wooden roof was afterwards placed over them. In the church of *St. Front*, at Périgueux, the same arrangement has been made; but in the church at Loches, where there are two similar cupolas in the nave, they are still exposed externally and form two cones.*

Touching the foundation of the cathedral, and the age of the present building, it is stated that Clovis rebuilt a church here, and dedicated it to St. Peter. Having been much injured by invading barbarians, it was restored and consecrated in 1017; but ultimately, namely in 1120, was taken down and rebuilt "*a primo lapide*." Several of the French writers wish to insist that the western front was not pulled down at this time, but that it is a remnant of the structure built by Clovis! This opinion, however, is quite untenable, as the front is evidently not earlier than the 12th century. The church was greatly injured by the Calvinists in the 16th century, as it was also during the revolution of 1793, of which latter time a record yet remains in these words, sculptured over the entrance door, "*Temple de la Raison.*"

As another example (in fact, perhaps, constituting with Notre Dâme de Poitiers, the three chief examples in France) of a class of buildings little known to us, I annex a view (Fig. 8,) of the extraordinary western front of the church of St. Nicholas, at Civray, situated between Poitiers and Angoulême, and is attributed to the 12th century. It was not drawn on the spot, but is reduced from a very correct engraving of it, published by M. Thiollet, and will serve to give a clear notion of its arrangement. In the upper of the two stories into which this façade is divided, three arches occupy the whole extent, and display some extraordinary bas reliefs; on the left hand side two figures occupy the place of columns, and support the arches. The doorway in the centre of the lower story is very richly decorated with sculptured figures, as are the arches adjoining the space beneath, each of which is subdivided by two pointed arches, also elaborately adorned. The signs of the zodiac occur more than once on this very remarkable front.

Fig. 8.



The history of that style of architecture which grew up in Byzantium, after the removal of the seat of empire from Rome by Constantine, is yet to be written. The extent to which it influenced the architecture of Germany, France, and England, was, until lately, very imperfectly estimated, and even now is not sufficiently so. The materials for such a work, which is unquestionably a *desideratum*, are neither few nor slight. Eusebius describes minutely many of the buildings erected by Constantine and his mother,* as does Procopius even more fully those built by Justinian.† Spon and other old travellers give descriptions of many of these edifices, which now no longer remain; and Hope,‡ Mr. Gally Knight,§ M. Albert Lenoir, and M. Mallay,‖ have each proceeded a considerable way in elucidating the subject. M. Lenoir, especially, in his architectural course, delivered at the *Bibliothèque Royale*, Paris, in 1838, and since published in the "Revue Générale de l'Architecture," has ably sketched out the work required.**

It seems quite clear that Constantinople was the great metropolis of the middle ages, and that at a period when Italy was deeply abased, skilful artists and artisans of all descriptions were to be found in the new city.†† They were accordingly sent for to all parts of the empire, and served to diffuse and make general the style of art there in use. Works in mosaic, if not originated by the Constantinopolitans,‡‡ were made so entirely their own as to become invariably termed *opus Græcum*, and *Byzanteum artificium*; and stained glass, fresco-painting, and other decorations, were brought by them to great perfection. The buildings erected by Constantine were coated with marble, and the cupolas by which they were covered were plated with gold.§§ The

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* *The internal length* of the building is 241 feet.

* *De Vita beatissimi Imperatoris Constantini. Liber tertius.*

† *De Ædificiis Domini Justiniani.*

‡ *Hist. Archit.*, *chap.* x.

§ *Normans in Sicily*, *chap.* xxii.

‖ *Essai sur les Eglises Romano-Byzantines du departement du Puy-de-Dome.*

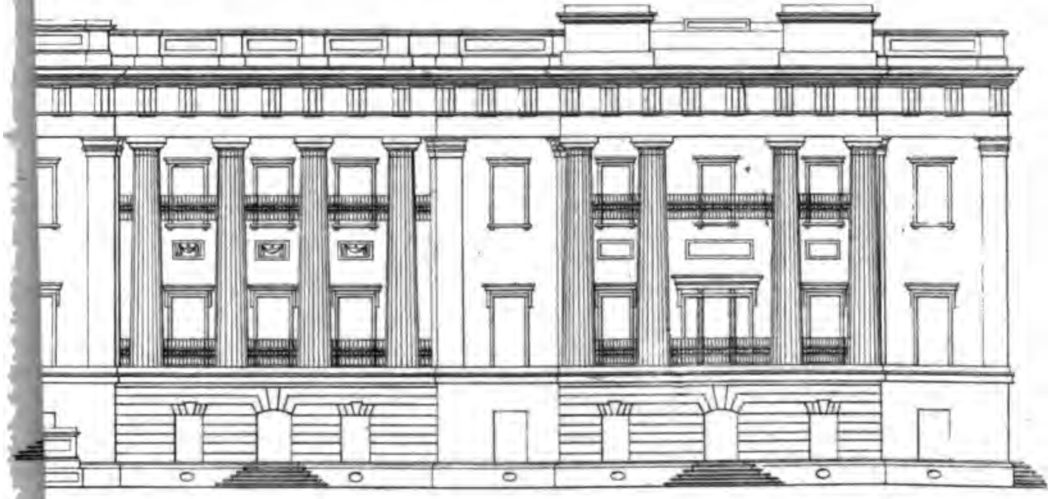
** Mr. Willis, in his work on the "Architecture of the Middle Ages," has made some valuable observations bearing on the subject. Dr. Möller's book, "Memorials of German Gothic Architecture," translated by Mr. Leeds, should also be referred to.

†† Gibbon gives a lively description of the magnificence of Constantinople. He says, "Some estimate may be formed of the expense bestowed with imperial liberality on the foundation of Constantinople, by the allowance of about £2,500,000 for the construction of the walls, the porticos, and the aqueducts. *Codinus Antiquit. Const. p.* 11. The forests that overshadowed the shores of the Euxine, and the celebrated quarries of white marble in the little island of Proconnesus, supplied an almost inexhaustible stock of materials, ready to be conveyed by the convenience of a short water-carriage to the harbour of Byzantium." Elsewhere he continues, "A particular description, composed about a century after the foundation of the city, enumerates a capitol or school of learning, a circus, 2 theatres, 8 public and 153 private baths, 52 porticos, 5 granaries, 8 aqueducts or reservoirs of water, 4 spacious halls for the meetings of the senate or courts of justice, 14 churches, 14 palaces, and 4,388 houses which, for their size or beauty, deserved to be distinguished from the multitude of plebeian habitations." Too much haste, however, led to too early decay.

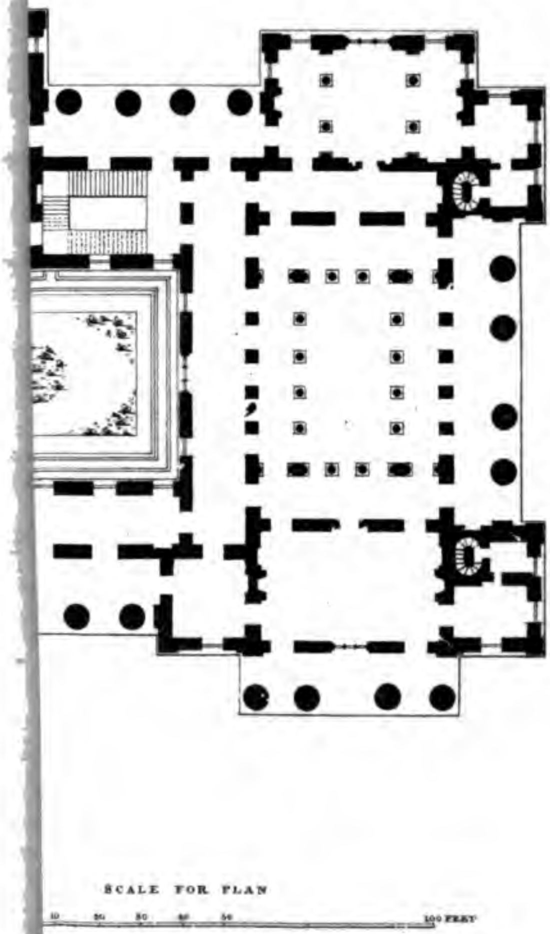
‡‡ An early instance of the use of inlaid work seems pointed out in the description of the palace of Ahasuerus (Book of Esther, ch. i. v. 6, ascribed to the year 521 before Christ), where a pavement is mentioned "of red, and blue, and white, and black marble."

§§ "Cumque templum omne in immensam altitudinem extulisset, vario lapidum genere splendidum reddidit, à solo ad cameram usque marmoreis crustis illud operiens. Porro cameram lacunaribus minutissime operis obducens, totam auro imbracteavit." Eusebius *ut supra*, "De constructione martyrii apostolorum Constantinopoli."

PLATE V.



OORSHEDABAD IN BENGAL.



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earliest buildings were circular, octagonal, or polygonic. Afterwards the exterior became a square, although the internal plan remained a circle or octagon. In Sta. Sophia, built by Justinian, in the erection of which ten thousand men were employed, the internal plan became a cross of four equal sides, known as the Greek cross, and this building was for a long time the model on which other structures were founded.[*] Elongated cupolas, superimposed tiers of small arcades, columns in recesses, larger arches, or circular-headed openings containing within them two or more smaller arches, and plain square or basket-worked capitals to the columns, are some of the details that were then introduced. "In this new shape," says a French writer, (M. Vitet,) "which in truth causes the exclusive admirers of antique purity to shudder, but nevertheless is entitled to the more indulgent praise of the true lovers of the beautiful, the genius of the old Greek architects awakened; less correct, less severe than before, but brilliant with youth and life—more daring, more marvellous. For the second time the Greeks seized dominion over the grand and beautiful art of architecture: it was from them the Arabs received the secret of it; it was by them that its first lessons were imparted to all Europe."

It is somewhat curious to find that Theodoric, King of the Goths, was educated at Constantinople, and ever retained a love of the arts he had there seen practised.[†] Ravenna, which was the seat of the Gothic court, vied in magnificence with Rome; and here we find many admirable structures erected both then and in after times. To ascribe this style of architecture and all that it led to, to the Goths, as some Italian and other writers have done, seems absurd, and has long ago been combatted; we must go back to Byzantium for its origin.

In the year 553 the Goths were conquered, and Italy was once more united with the Greek empire. Soon afterwards great part of Italy was seized by the Lombards, who made Pavia the seat of royalty, and raised many structures. To ascribe to them, however, the origin of the style of architecture which prevailed in the mis-called dark ages, seems to be equally erroneous; they but copied and further modified the architecture of Byzantium.

Charlemagne raised many edifices in imitation of Byzantine structures, surmounted with cupolas, in Mayence, Aix-la-Chapelle, and in various other parts of Germany and France, by means of which architecture, which had fallen into abeyance, revived, and received a fresh impulse. The church of St. Front at Perigueux, restored on the original model probably about the 11th century, is one of these. Like the church of Sta. Sophia, the plan is a cross of four equal arms, surmounted by five cupolas on tambours, but which are now hidden externally by a wooden roof. The windows are in threes, connected by a label: each front of the edifice originally terminated with a gable or pediment, but this was in later times filled in, so as to form a straight line round the building, and to receive the wooden roof before spoken of.

Churches on a circular plan, in imitation perhaps of that built by Helena over the Holy Sepulchre at Jerusalem, are not uncommon in France. The church of Charron in the department of Vienne, of which some fine ruins remain, is a good example. The greater part of the structure, as now seen, is of the 11th or 12th century: at the west end are two turrets with conical stone roofs in scales, similar to those at Notre Dâme de Poitiers.

To recall the connection with Byzantine architecture apparent in the buildings more specially spoken of in this and the foregoing chapters is, perhaps, unnecessary: the series of small arcades and sculpture in the principal front, the mosaics, the use of external painting, and the occurrence of cupolas, are all fresh in the mind of the reader. In Germany, where perhaps more than in any other country Gothic architecture, as we now see it, was earliest developed, all the older buildings are decidedly Byzantine. In Cologne, especially, the derivation is so strikingly apparent, that none who visit that most interesting city can fail to observe it. In Saxon England, it seems certain that Byzantine architecture was the model chiefly followed. The abbey church at Hexham, built in the seventh century by Wilfrid, was surmounted in the centre of the transept by a cupola; there were galleries for the women; the arch of the sanctuary and other parts were decorated with histories and images; and the stone work was painted with a variety of colours. The fact that the term *more Romano* was constantly applied to the buildings of this period, does not seem to contradict the position. Constantinople *was regarded* as a second Rome, its citizens were termed Romans; moreover, we know this description is repeatedly applied by early writers to this very building at Hexham.

We reach truth slowly, and by painfully small degrees: some few detect a fact, others corroborate it in part, information bearing on the point is collected, inferences become apparent; and ultimately a mind arises to lay hold of all that has been said previously, to get rid of the difficulties, and digest the whole into a system. A very few years ago the greatest obscurity prevailed with respect to the semi-circular style, and it was universally called Saxon in works specially devoted to the subject, to distinguish it from the pointed, which was then termed Norman. Writers afterwards, in an equally erroneous manner, as I humbly conceive, termed every building wherein the semi-circular arch was used Norman, without any regard to the country where it was found, or the period which produced it. And even at this time, when so much is being done for the elucidation of architectural history, many still remain with very confused ideas upon the subject, and vacillate between the terms Romanesque, Lombardic, Norman, and Byzantine, often applied indifferently to the same edifices. Let us seek for the truth.

THE NEW PALACE OF MOORSHEDABAD, IN BENGAL.

ERECTED FOR HIS HIGHNESS THE NUWAUB NAZIM,

BY MAJOR-GENERAL M'LEOD.

(With an Engraving, Plate V.)

AT one of the evening meetings at the commencement of the present session of the Institution of Civil Engineers, our attention was attracted to the exhibition of two very splendid water-colour drawings by Mr. John Edward Jones, being perspective views of a palace built in India for one of the subsidiary princes. Upon inquiry we ascertained that this palace had been recently erected, entirely from the designs and under the immediate superintendence of Major-General M'Leod, who, in consequence of an application from us, very handsomely directed Mr. Jones to favour us with whatever drawings we were desirous of having for the service of the *Journal*. For this purpose we selected the plan of the principal floor, and the elevation of one of the principal fronts. We have also subjoined the report of the Committee appointed by the Indian Government to inspect the new palace; it fully describes the nature of the building, and to what purpose the several rooms are appropriated. Without entering into a minute criticism of the architectural character of the building, it must be admitted by all to be one of unusually princely magnificence, and one that will be a lasting honour to the talented General to whom the erection was entrusted.

Report of the Special Committee of Inspection, dated Calcutta, 10th Nov. 1838.

WE have the honour to submit, for the information of his honour the Deputy Governor of Bengal, the result of our proceedings consequent upon the receipt of your letters of the 12th, 19th ult., and without date, received at Moorshedabad, from the Governor General's agent, in regard to the Nizamut buildings at Moorshedabad.

The new Palace is in length 425 feet, by 200 feet in breadth; and of one order of architecture throughout the whole of its exterior, without any intermixture of the same on a reduced scale, or of any other order. It stands on a slight elevation, produced by raising the foundation walls three feet above the general level of the ground, and filling up with earth to that height, in a gradual slope, to the extent permitted by the surrounding buildings, and the termination of the premises towards the river, on the banks of which the palace stands—a conspicuous and imposing feature in the landscape from a great distance. The effect anticipated by raising the structure, as just described, has been fully accomplished.

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[*] St. Mark at Venice, built by a Greek architect, was one of its offspring, as was the Basilica at Pisa, also by a Greek architect.

[†] *Russell's Hist. of Modern Europe, vol.* i.

The order employed is the Grecian Doric. It is forty-six feet nine inches in height, having fluted columns thirty-six feet high; five feet six inches in diameter at the base, and four feet one and a half inches at the neck, with corresponding antæ, and an entablature of ten feet nine inches; the whole surmounting a basement of eighteen feet six inches, of which three feet six inches forms the plinth of the building. Over the entablature are parapet walls, varying in height according to circumstances, and ornamented with panels, plinths, and cornices. The projections of the cornice of the order are of stone, having the guttæ and lilies in the angles cut out of the solid. Nothing could be more satisfactory than the execution of the whole detail of what this involves. The Doric order is notoriously of difficult management, when applied to edifices of complicated design, from the necessity of observing the rules prescribed for the introduction of the triglyphs in the frieze of the entablature. In the present instance, with many projections and recesses, tending to create difficulties, there was not discoverable the slightest deviation from what these rules demand; the cornices and mouldings were noticed as being cleanly and sharply cut and defined, and all lines and surfaces, whether of stone or plaster, exhibited the most successful result of much labour and minute attention.

On the south front is a portico of eight columns, ninety-seven feet nine inches in length, surmounted by a pediment twelve feet high, and having a strong trussed roof of timber secured transversely by iron tie-rods. To the north is the entrance portico of six columns, measuring 70 ft. 9 in. in length, with a corresponding trussed roof to the pediment, which rises 10 ft.; in the tympanum of either pediment are the arms of the Nuwaub Nazim, perfectly executed in relievo, and forming a very appropriate and effective finish to the whole.

Leading to the northern portico, is a noble flight of stone steps, commencing in its breadth above from the centre of the end columns, and having a platform stretching out in the same parallel to a width of 24 ft. 9 in., from which, descending, it curves outwards on either side till it ends at its base, in a line extending to the length of 129 ft. There are two intermediate platforms, one of 10, and one of 5 ft. in width; in a line with which last, at the extremities, are well proportioned pedestals with stone slabs, bearing inscriptions (the letters cleanly cut in relief) in English and Persian, exhibiting particulars connected with the erection of the edifice (enclosure No. 1), and in front of these pedestals, on blocks carried out from their bases, corresponding in height and breadth with the last flight of steps, and 10 ft. 6 in. in length, are placed two sphinxes, admirably executed, both as regards the design and workmanship. They are of solid teak, but painted and sanded so as exactly to resemble stone, and form highly ornamental appendages to the entrance in the position they occupy. Iron railing, of a graceful pattern, corresponding with that of the colonnades (rising from which are five lamp-posts on either side, with three on either pedestal below,) surmounts the flight at either extremity. Underneath is a capacious carriage way; and there are three vaulted ranges, two of them open, and one (the lowest) closed in, and forming *âbdarkhánesh* and other useful offices.

To the north front are two smaller porticos (to the wings) of four columns each, and intermediately between the centre and wings on either front, receding colonnades; which also form leading features of the end fronts of the building.

To all the above colonnades, including the porticos, are continuous balconies to the third floor, 4½ ft. wide, of light appearance but of great strength, being constructed of iron beams or cantilevers from 19 to 21 inches apart, inserted in the walls between stones to a depth of 1½ ft., and supported on brackets at intervals, the rest of the material of the floor being of flat bar iron. The floor is composed of tiles, terras, and marble, confined by a plate or band of iron. The railing is partly of iron and partly of teak; the main supports and some of the rails being of the former, upheld by brackets branching from the cantilevers.

The spaces over the doors and windows within the colonnades, as well as those of the treble windows in the exterior walls, are relieved by panels, in which are inserted ornaments of various descriptions, in relief, of good design, and extremely well executed.

There are two open courts in the interior of the building, 72 by 52 ft., finished in every respect in the same style as the exterior, having substantial drains all round, communicating with large covered ones externally, which are carried to a considerable distance, and empty themselves into the river.

Round the exterior of the building there is a platform of the finest masonry, bricken-edge, 7 ft. wide, from which spring small flights of stone steps to the height of the plinth, leading to the entrances in the several compartments of the edifice; outside of which is a roadway or walk, of corresponding breadth, composed of *koah*, 9 in. in depth. The plinth of the building has oval flue openings of 22 by 18 in., furnished with strong iron gratings;—where flights of steps interfere, three of the step-facings in each have gratings, of 18 in. in length, fixed into them.

The interior comprises a basement floor, from 13 ft. to 13 ft. 3 in. in height to the beams; a principal floor, from 21 ft. 9 in. to 22 ft. in height, to the ceilings; and a third floor of the same height as the latter.

Principal floor. The principal entrance is from the north portico into a vestibule 36 ft. by 27 ft., having a geometrical stone staircase at either side, 7 ft. 6 in. in width, with iron railing and mahogany hand-rail, each staircase receiving light from four painted glazed windows. Within this range is a corridor or passage, 12 ft. wide, leading to the wings of the edifice, divided into compartments, and so contrived, that by shutting two doors the communication with the wings is cut off, without any interruption to that between the other portions of the building. From the centre of the corridor a large door opens into a circular room 50 ft. in diameter; to the right and left of which (on entering) is a room 52 ft. by 25 ft.; the three comprising one suite of apartments, separated from the wings by the open courts, (noticed above). The circular room is of the Corinthian order, taken from the temple of Jupiter Stator at Rome. The order is in height 30 ft. 6 in., with pedestals of 4 ft. 6 in. From the entablature, on a line with the frieze, springs a cupola of masonry, with sunk panels, ending in a painted glazed skylight 20 ft. in diameter, the height from the floor to the opening of the skylight being 56 ft., and to its apex 62 ft. The room is decorated in its circumference by four large covered recesses, over which are long panels, eight pilasters, and four large doors; over which last are oval openings occupied with pierced screens of arabesque, cut in single slabs of stone. All the mouldings and compartments are richly carved and ornamented, in conformity with the rules of the order of which the apartment is composed; and, whether as regards the effect of the whole, or the exquisite finish of the details throughout, it is impossible to speak too highly of what has been accomplished. There is nothing to add, and nothing to alter: the architect and builder have done their work perfectly. To the south of the above suite is a grand colonnaded saloon, measuring 187 ft. 6 in. in length, susceptible of division at pleasure into three apartments, by means of sliding doors 18 ft. 2 in. wide, the leaves sliding into cases, faced on both sides, from the bottom to the top, with mirrors. The general width of this saloon is 55 ft., the centre space within the bases of the columns being 25 ft. Beyond either extremity of the saloon is a geometrical stone staircase, 5 ft. 3 in. wide, with railing, as before described, communicating with the apartments of the wings.

The wings do not correspond internally with each other: both are divided into apartments of various suitable dimensions, each having a spiral stone staircase at either corner, with baths, dressing rooms, &c.

With the exception of the circular room, the interior of the whole of the principal floor is of the Roman Doric order.

On the third floor the dimensions of the several apartments necessarily correspond with those immediately below, just described, excluding the circular room, which comprehends both floors. In this third floor also is the same arrangement of the saloon as that described for the principal floor, but the order throughout is the antique Ionic, 19 ft. high, with fluted columns, pilasters, &c., surmounted by a coved ceiling rising 2 ft. 9 in.

The whole of the apartments in both these floors are ceiled with canvas, or teak wood frames, through which are fitted into the beams strong brass hinge-hooks for punkahs, and brass for lamps or lustres, to an extent ample for every purpose of use or ornament. In both floors the doors are painted in imitation of different woods (satin wood, mahogany, oak, maple, &c.) and highly varnished; and, with a few exceptions (in the minor apartments of the wings) they are fitted with plated locks, bolts, and hinges, and hand-guards; also on the principal floor. All the apartments in the wings of both floors are coloured in distemper, in light tints of various colours; and the walls, as high as the surbase of the vestibule, and four staircases, are painted in imitation of marble; all with very good effect. There are twelve fire-places, with carved mantel-pieces of teak, also painted and varnished in successful imitation of rare marbles. The floors of the whole of the public apartments of the principal story, including the vestibule and landing places of the great staircases, are paved with polished marble; and those of the corresponding apartments in the third story, with the landing places of all the four staircases, are laid with teak boarding. The whole of the public rooms in both floors, and the columns in the wings, are finished with polished stucco, in imitation of the Madras chunam; and it may here be observed, that the flutings and finishings of all the columns, exterior and interior, are remarkably well defined, and evenly and sharply wrought; a completion very rare, where brick and plaster are the materials, in houses even of the highest pretensions in this country.

The basement floor is finished in a plain style, having a simple moulded band under the beams and no ceilings. The doors and windows are of appropriate substantial construction, fitted with brass locks, bolts, and hinges, and painted plainly. Under the circular room (of paragraph 15) are four strong lock-up closets for treasure, plate, jewels, or other articles of value, with a large open space for a guard. In the arches of the treble windows of this floor, fifteen in number, are coloured fan-lights. In the west wing is a steam-bath, complete in all respects, executed subsequently to the erection of the building, as we were informed by Colonel M'Leod, at the particular desire of the Nuwaub Nazim. All the exterior colonnades and porticos in the basement and principal floor, as well as the vestibule and staircases of the basement, are paved with stone.

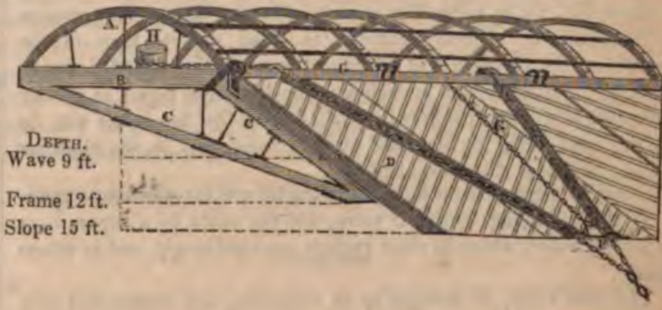
Pleasure Grounds.—Koah roads, twenty feet wide, have been constructed, and well rolled, in all that portion of the ground about the Palace which has yet been cleared of old buildings; the banks of the river have been sloped off and sodded throughout the whole extent (with the exception of a very small portion, for which it seems earth was not procurable) and stone posts have been inserted along the top, as fastenings for boats. The whole of the ground (cleared) has been smoothed and grassed, and completely drained. At a short distance, in front of the Palace, is a handsome sun-dial, five feet in diameter, a surplus stone so converted by Lieut. Cunningham; it rests on a pillar based on stone steps, and forms a useful and appropriate appendage to the premises. A substantial stone ghat, fifteen feet wide, has been constructed near the Palace for the convenience of the Nuwaub, and at about 800 yards to the south of the Palace a large *Noubulkahneh* gateway has been erected, as an entrance to the grounds in that direction. As it was not immediately in view, there did not appear to be any objection to its being built in a style of architecture adapted to its purpose, and the Asiatic or Turkish has been adopted.

In concluding this head of our report, it seems proper to advert to the fact of this edifice, in all its departments, having been constructed and completed by natives of the country; the only exceptions to which remark are in regard to the painting and glazing, which portions of the work were executed by professional Europeans. The expressions of approval which will have been found interspersed with the preceding details, were elicited by particular features of the building under review, inviting a more peculiar attention from their importance, or the effect produced by them on the eye of the observer; but they are equally applicable to every part of the structure, which, whether considered as a work of art to be admired for its exceeding beauty, or as an example of skilful labour applied to the practical combination of excellent materials, reflects the highest credit on the architect, and all subordinate to him, concerned in its erection. The late rainy season was one of uncommon violence, and had just closed when our survey was made, and the soil far and wide was either inundated or saturated with moisture. Nothing could have more searchingly tested the strength and solidity of a newly erected edifice; but not a crack or symptom of yielding was to be seen, externally or within, throughout the whole extent of this fabric; and we conclude our remarks upon it with the expression of a grateful anticipation, that a lengthened durability awaits what we have represented as so pre-eminently worthy of a lasting preservation.

In conclusion, we would here recapitulate, in a few words, the opinion to which our inquiries have led regarding the three points to which reference is made in the second paragraph of our report. As to the execution of the works, our verdict, after a careful examination of all that presented itself to our view, is one of unqualified approval and commendation.

REID'S FLOATING BREAKWATER.

Floating Breakwaters are at the present moment occupying much of the public attention, which has induced me to turn my mind to the subject: the result of my labours I submit to your notice. The objection of a gallant officer in the House of Commons to floating breakwaters, because chain cables would last only a few years, is but a trifling *objection*. If the success only depends upon the *cost of cables*, the ships and property, not to speak of lives saved, would fully compensate the country for occasionally laying down new moorings.



Explanation of Engraving.

A is an arched frame of timber in thicknesses, 6 ft. high in the centre; B frame of timber bolted together, 2 ft. square, and 20 ft. long on the chord line; C sloping frame of timber, 1 ft. square, secured with iron straps, bolts, and stays, and protected at the point by iron shoes; D inclined plane on shutter 24 ft. 6 in. long, laid to an angle of 35°, with planking laid diagonally and bolted to a framework of timber, the planking need not be laid close, there may be a space of 3 or 4 in. between; E iron cable; F bridle, and G chain for lifting shutter; H bit or head to which the cables are secured.

If the depth of the wave be 9 ft. below the chord bar of the arch, there will be 6 ft. (perpendicular) of the shutter below that, the inclined plane will underrun the wave, and the arched frame work above will offer a gentle resistance for the wave to fall upon, and distribute itself harmless. There will be no strain upon the hinges, the cables being secured to bits in the centre of the raft. When the sea strikes the front of the inclined plane, the framework will yield, and the hinges will prevent that sudden check which the cable tightening would give to the work. Were they not there, the frame would almost instantly resume its place; the buoyancy of the shutters takes all weight from the hinges. The principal use of the hinges to the shutters is for the more easy recovery of the moorings. A small chain attached to the shutters will enable them to be weighed at pleasure; when at the surface they are easily hung to lighters. The iron plates on the shutters under the moorings are to prevent the wood being chafed away by the friction. Each shutter is proposed to be 30 ft. long; the raft can be increased to any height, though 60 ft. broad would be sufficient for the heaviest sea that ever ran. Unlike a beach, there would be no back run of water; and a raft of such breadth would have the effect, from its own hold in the water, of rendering the whole front stationary, at least this, I imagine, would be so. I should think 20 ft. perpendicular depth would also be deep enough for any weather. One of moderate dimensions, tried in a moderate sea, would prove its efficacy. It is an idea formed after considerable reflection, upon seeing plans of others, and hearing objections urged. If it should prove successful, 'twill be a double pleasure; and the lives it may be the means of saving will not be the *least* portion of such gratification.

March, 1842.

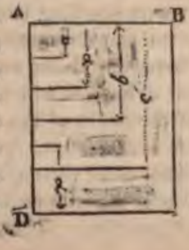
ON THE ECONOMY OF FUEL IN MARINE ENGINES, AS PRODUCED BY EXPANSION.

By J. G. Laurie.

In prosecuting the investigation of expansion, I now come to consider it with reference to economy of fuel, as applied in marine engines. In former numbers of this Journal I have investigated its effect in locomotives; but important as economy of fuel is in them, it is of vastly greater importance in marine engines, the result in the one case being only a diminished expenditure, and in the other the accomplishment of passages otherwise quite unattainable. In sea-going steam vessels, subjected to varying weather and tempestuous voyages, the application of expansion is as beautiful in theory as beneficial in practice. By its means the power of the engine both statical and dynamical is most beautifully adapted to the necessities of the vessel, for by extending or contracting the degree of expansion in favourable or adverse weather, the mean statical force of the engine and the resistance of the vessel are, within extended limits, exactly proportional; and in each case the dynamical power is greatly increased over what it otherwise could be, and that too in the way (in the one case being by increased statical force, and in the other by speed,) in which it is most available.

In marine engines there are two means in use for effecting expansion; the one being by the D valve, and the other by a separate or expansion valve, which in some engines are used singly, and in others jointly.

The slide valve, as wrought by an eccentric, and constructed with only sufficient cover to keep it tight, seems admirably fitted to the purpose for which it was introduced, but does not seem so capable of carrying out the principle of expansion, for, in the first place, it does not afford the means of varying the extent of expansion, and, in the next place, when expansion is to be carried to any considerable extent, it opens and shuts the ports in a manner that has the effect of virtually diminishing the size of the engine. In proof of this, by referring to my communication in No. 47 of this Journal, it will be found proved that, if A B C D be a steam cylinder, A D the stroke of the piston $=2d$; the radius of the eccentric $=a$; the cover of the valve on the steam side $=c$; distance from commencement of stroke to commencement of expansion $=a'$; distance from commencement of stroke to termination of expansion $=b$; $a'=\frac{2d\,(a-c^2)}{a^2}=2d\times(1-c^2)$ when $a=1$ $b=\frac{a^2d+d\sqrt{a^4-a^2c^2}}{a^2}=d+d\sqrt{1-c^2}$ or for a particular and perhaps an extreme case, take $c=\frac{3}{4a}$ and then $a'=2d\times\frac{7}{16}$ and $b=2d\times\frac{3{\cdot}3}{4}$ which proves that when there is cover on the steam side only of the valve, and when that cover is sufficient to expand the steam from 1 to 1·9, the whole available volume of the cylinder for receiving the steam from the boiler, and for expanding that steam, does not exceed $\frac{3{\cdot}3}{4}$ of the cylinder, nor does it come to be quite so much as that, for at the same moment that expansion terminates on the one side of the piston, compression of the enclosed vapour commences on the other, which can be viewed either in the light of detracting from the power already developed by the piston, or of diminishing (which it does in reality) the available part (a') for receiving fresh steam from the boiler. If less cover be given to the valve, the evil here pointed out is also less; and when the cover is small, it seems to be quite overbalanced by a property which shall be hereafter explained. But if, on the other hand, greater cover be given them, it is more than proportionally increased, and comes to be of serious amount; to avoid which the valve is frequently constructed so that it shall have cover on the eduction side as well as on the steam side. If these covers be equal, then at the same time that the steam is cut off from the side of the piston, the eduction is cut off from the other, in consequence of which, although the available part (b) is increased by giving cover to both sides of the valve, the available part (a') is decreased, and, in addition, the period of time for which the educting side of the piston is in communication with the condenser is greatly shortened; if, however, the cover on the eduction side be less than the cover on the steam side, this effect of compression of the enclosed vapour will be diminished, and the period of time for condensation lengthened, but so will also the available part (b) of the cylinder be diminished. Hence betwixt the advantage of increasing the part (b) of the cylinder, and the disadvantage of diminishing (a') and shortening the period of time for condensation, there is some extent of cover of the eduction side of the valve, which shall in the greatest possible degree secure the one and avoid the other. The exact magnitude of this might (but with great difficulty, from the nature of the analysis, which is lying before me,) be ascertained analytically; but though it were ascertained with all conceivable precision, still the plan of expanding by the slide valve has the effect of diminishing the available size of the cylinder, and, therefore, to employ the steam produced by a given boiler, that steam being expanded to a given extent, will require a cylinder, and, consequently, an engine, larger when that engine expands by the D valve than when it expands by a valve which does not diminish the available volume of the cylinder, which, even though there were no other reason, would, in engines of considerable magnitude, in which alone expansion is much used and is most serviceable, prevent the adoption of expanding by the slide valve, and give a decided preference to a separate one being employed for the purpose.



To expand by a separate or expansive valve there have been almost numberless schemes, the principal of which are throttle, slide, and conical valves, of various constructions and variously situated, each of which has in its turn had some claim to superiority over every other. The great aim of the various plans seems to have been to cut off the steam close to the cylinder ports, for the attainment of which, in many cases, means are resorted to that are both difficult of execution and troublesome to keep in order. The evil produced by placing the expansion valve at some distance from the cylinder port is two-fold. In the first place, such an arrangement fixes a limit to the extent of expansion depending on the ratio of the volume of the cylinder to the volume of the steam betwixt the cylinder port and the expansion valve; and the next place, the effective power of the steam throughout the stroke (or in other words, the area of the indicator diagram,) is diminished, the amount of which diminution may be thus estimated. Let volume of steam cylinder $=a$; volume of steam betwixt cylinder port and expansion valve $=b$; pressure of steam at commencement of expansion$=p$; pressure of steam at termination of expansion$=s$. Then, efficiency of whole stroke of piston$=s\,(a+b)\ \log.\frac{p}{s}+1)-b\,p$

or put $a=1$ $p=1$

and then efficiency of the whole stroke $=s\,(1+b)\ (\log.\frac{1}{s}+1)-b$

To find from this what would be the efficiency were the expansion valve close to the cylinder port, put $b=o$; and hence—

Efficiency when valve is close to cylinder port$=s\ (\log.\frac{1}{s}+1)$

Do. when valve is at a distance (b) from do.$=s\,(1+b)\ (\log.\frac{1}{s}+1)-b$

which formulæ assign the amount of injury entailed upon an engine by any given position of expansion valve, and, therefore, the amount of preference due from this cause to one valve over another. But by substituting for (b) its value, in practical cases we find that the amount of the injury is by no means of sufficient importance to warrant the exclusion of all expansion valves that do not cut off close to the port; and by making a comparison of the three, namely, the slide inserted betwixt the D valve and the face of the cylinder, the slide valve in the inside of the cylinder steam jacket, and the double-beat conical valve (the three which seem to be at the present time of the greatest importance). Taking into consideration simplicity of arrangement, simplicity of execution, facility to keep in repair, and efficiency of action, including facility of altering the degree of expansion, we are led to believe that the double-heat expansion valve is the one which, in the aggregate, is the best. This valve (b) in well constructed engines does not exceed one-thirtieth; but as an average case, take one-fifteenth of the volume of the cylinder, and by substituting this value of (b) we find the loss of effect of the steam from having one-fifteenth of the whole volume of the cylinder betwixt the cylinder port and the expansion valve to be— $\dfrac{0{\cdot}06\cdot - s\times 0{\cdot}06\cdot\ (\log.\frac{1}{s}+1)}{1{\cdot}06\cdot\, s\ (\log.\frac{1}{s}+1)-0{\cdot}06\cdot}$ or when $s=\frac{1}{4}$ to nearly 4¾ per cent. of the whole power developed by the engine, which points out the propriety of putting the valve as close to the D valve casing as possible.

Adopting then the double beat conical valve, the economy of fuel as produced by expansion may be thus estimated. Let the volume of steam cylinder when there is no expansion$=a$; volume of steam betwixt cylinder port and expansion valve$=b$; pressure of steam at commencement of expansion$=p$; pressure of steam at termination of expansion$=s$. Then $s : p :: a :$ volume of cylinder when expansion is carried to extent (s) $\therefore$ increased volume of cylinder$=\frac{ap}{s}$ but (b) must be taken proportional to the volume of the cylinder $\therefore a : \frac{ap}{s} :: b :$ increased volume betwixt cylinder ports and expansion valve

$\therefore$ ditto $=\frac{bp}{s}$ and by substituting these values of (s and b) in the formula $s\,(a+b)\log.\frac{p}{s}+1)-bp$, we find that with the expansion (s) the efficiency of a given quantity of steam is $(ap+bp)\,(\log.\frac{p}{s}+1)-\frac{bp^2}{s}$. Put in this $a=1$ $p=1$ $b=\frac{1}{25}\times$ volume of steam cylinder, which, in well constructed engines, it will not exceed, and efficiency $=1{\cdot}04\times(\log.\frac{1}{s}+1)-0{\cdot}04\times\frac{1}{s}$

Let $s=1$ which is the case of no expansion, and efficiency $=1$
" $s=\frac{3}{4}$ which is the case of the steam
being cut off, when stroke ¾ finished & efficiency$=1{\cdot}285$
" $s=\frac{5}{8}$ " " ⅝ " $=1{\cdot}4$
" $s=\frac{1}{2}$ " " ½ " $=1{\cdot}68$
$s=\frac{1}{3}$ " " ⅓ " $=2{\cdot}06$
$s=\frac{1}{4}$ " " ¼ " $=2{\cdot}32$
$s=\frac{1}{8}$ " " ⅛ " $=2{\cdot}88$

And hence the following conclusions:—

If the work done by a ton of coal when the steam is used without expansion be represented by unity, the work done by the same fuel when the steam is used expansively to the extent of reducing its pressure to ¾ of its original pressure, is represented by 1.285.

And when to the extent of reducing
its pressure to . . . . ⅝ the work is represented by 1·4
" " " ½ " " 1·68
" " " ⅓ " " 2·06
" " " ¼ " " 2·32
" " " ⅛ " " 2·88

In a former part of this paper it was mentioned that it is advantageous to construct the D valve with a small extent of cover, notwithstanding its effect of diminishing the available volume of the cylinder, and for the following reasons:—when the piston of the steam cylinder is near either end of its stroke, the effective leverage of the crank to turn the paddle shaft is small; and although the amount of power developed by a given quantity of steam is at every part of the stroke precisely the same, yet, in consequence of the varying leverage of the crank, that portion of the power applied to overcome resistance at the extremity of the paddle wheel arm is by no means the same, being diminished at no two parts of the stroke by the same quantity, to overcome friction; for as the leverage of the crank decreases, that of the friction on some of the journals, in reference to the power, increases. And beyond a certain point, it is very questionable if (the engine being deprived of all momentum,) any amount of power that could be applied to the crank pin would bring the crank to the perpendicular position, and therefore for a certain portion of the stroke at each end, the steam not only does not increase the efficiency of the engine, but detracts from it, by the amount of power necessary to overcome the friction produced by its application; and hence the propriety of the plan adopted by some makers, of constructing the D valve with so much cover as causes the eduction to commence before the termination of the stroke, and the average vacuum effected before the return stroke has advanced to that point when the steam begins to be effective. The extent of cover necessary to effect this object is quite beyond the power of analysis to assign, and perhaps no two engineers have from their observation arrived at exactly the same conclusion; but I should say that constructing the D valve with only sufficient cover on the eduction side to keep it tight, and with from 0·25 to 0·3 of the breadth of the port on the steam side, would probably with the average of cases be not far from the truth, with which construction the cylinder would be in communication with the condenser from $\frac{1}{12}$ to $\frac{1}{10}$ of the whole time, for eduction before the termination of the stroke.

Greenock Foundry, 15*th April*, 1842.

ON THE SKEW ARCH.

An analytical investigation of the principal properties of the Skew Arch. By a Workman.

Let A B C D, $a\,b\,c\,d$, be the plan of the semicylindrical arch, the elevation on the skew of which is represented by A G B b F a; draw a K perpendicular to the axis H E R, and G E perpendicular to A B, and N n n' parallel o a K; let the spirals, which commence from n n', intersect the skew elevation in the points S s, join S and s, and produce this line to meet the axis G E produced if necessary in O, the line E O is stated by Mr. Buck to be a constant quantity, the investigation of which will form the subject of this paper.

The subject of inquiry seems to demand the complete solution of the two propositions.

First. To determine the intersections s and S of the spirals commencing at n n', with the skew elevation a F b and A G B.

Second. To determine the point where the line joining S and produced meets the axis G E.

ig. 1.

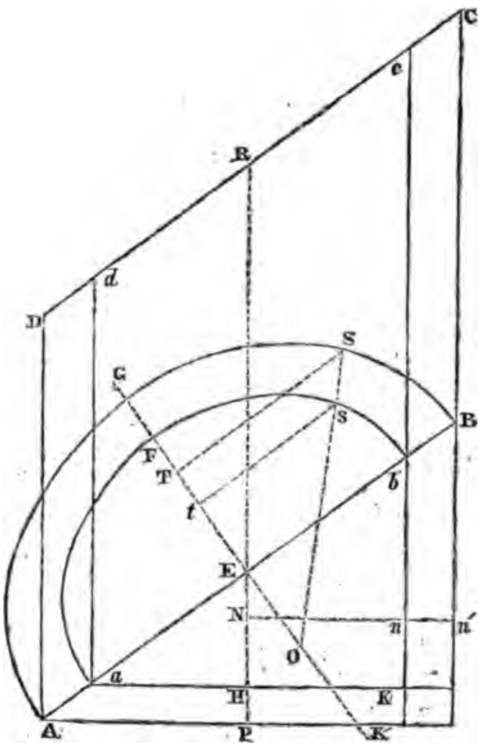
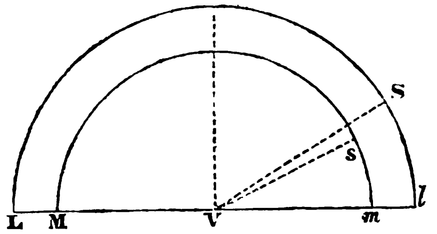


Fig. 2.



Let L S l and M s m be two square sections at right angles to the axis, and passing through the points S and s respectively.

b K$=b$ which is called the obliquity of the bridge.

$a=$ axil length (see Buck on oblique arches).

r R$=$E F, E G radii of the semicylinder respectively.

$w=$H N, $n=3{\cdot}14$, &c.

$\angle\, s\, V\, m = X$ and $\angle\, S\, V\, l = X'$.

Let x, y, z, be the rectangular co-ordinates of the point s, origin at H, Z measured vertically, and x on the line H K.

First for this point s we have the following equations:—

$$x = r \cos. X,\quad y = w + \frac{a\,X}{n},\quad Z = r \text{ Sin. } X \qquad (1)$$

These equations are too obvious to need any further explanation.

Next, to find the equation of the elliptical face a F b, let x' y' z' be the rectangular co-ordinates of any point in this face, referred to the same axis and origin as before, Y the angle made by a section passing through this point parallel to the section L S l

$$\therefore\ x' = r \cos. X,^{*}\quad y' = \frac{(1+\cos. Y)\,b}{2},\ z' = r \sin. X \qquad (2)$$

At the point of intersection of these two lines, namely, the and the ellipse, which is formed in the skew elevation, we mus the following obvious conditions:—

$$x = x',\ y = y',\ z = z' \quad \therefore X = Y$$

Consequently $w + \frac{a\,X}{n} = \frac{(1+\cos. Y)\,b}{2}$

By reduction we have $x - \frac{n\,b}{2\,a} \cos. X = (b - 2\,w)\frac{n}{2\,a}$ (3)

the equation for the intrado.

The equation to the extrado is a similar one to that of the ir viz.—

$$X' - \frac{n\,b'}{2\,a} \cos. X' = (b' - 2\,w')\ \frac{n}{2\,a} \qquad (4)$$

where $b' = b + 2$ K K$'$ and $w' = w +$ K$'$ K

$\therefore b' - 2\,w' = b - 2\,w + 2$ K K$' - 2$ K K$' = b - 2\,w$

by similar triangles $2\,r : (R - r) :: b :$ K K$'$

$\therefore 2$ K K$' = \frac{R\,b - b\,r}{r}\ \therefore\ b' = \frac{b\,R}{r}$

Substituting these values in equation (4) we shall have fc equation of the extrado—

$$X \qquad .\ \frac{R}{r} \cos. X' = (b - 2\,w)\ \frac{n}{2\,a} \qquad (5)$$

Now it is easily seen from equations (3) and (5) that the foll relation subsists:—

$$(X' - X)\frac{2\,a\,r}{n\,b} = R \cos. X' - r \cos. X \qquad (6)$$

If we assume X any arbitrary quantity along the intrado c skew elevation, the solution of equation (6) will give us corresponding extrado.

But it is easily seen that this equation cannot, by the present of analytical science, be generally solved. The best mode of eff an approximate solution is by the aid of Lagrange's theorem, as by Lacroix (see his calculus differential and integral); but this rendered unnecessary by the aid of the following proposition:–

To determine the point O, where the line joining the poin intersects the vertical radius, draw $s\ t$, S T, perpendicular t respectively, and call $\angle\, a\, b\, K = \theta$

$t\ s = r \cos. X \times \text{cosec. } \theta$ and T S$=$ R cos. X$'$ $\times$ cosec. θ

by similar triangles T S $:$ $t\ s$ $::$ T O $:$ tO

that is $t\,o = t\,E + E\,O = \frac{t\,s \times T\,O}{T\,S} = \frac{t\,s}{T\,S} \times (T\,E \times E\,O)$

by substitution and transposition we have as follows:—

$$E\,O = R \times r\left(\frac{\text{Sin. } X' . \cos. X - \text{Sin. } X . \cos. X'}{R \cos. X' - r \cos. X}\right)$$

$$= R\,r \times \frac{\text{Sin. } (X' - X)}{R \cos. X' - r \cos. X} \qquad (7)$$

by substituting the value of (6) in (7) we have—

$$E\,O = \frac{n\,b\,R}{2\,a} \times \frac{\text{Sin. } (X' - X)}{X - X} \qquad (8)$$

It will readily be seen from equations (3) and (5) that X$'$ is greater than X between the limits X$=$O and X$=\frac{n}{2}$; but (X$'$— stantly diminishes from X$=$O, then a maximum to X$=\frac{n}{2}$ whe (X$'$—X)$=$O. From this it appears that E O is not theoreti constant quantity; but in the construction of bridges (X$'$—X) whe maximum is so small,* that we may safely infer Sin. (X$'$—X)$=$

$$\therefore E\,O = \frac{n\,b\,R}{2\,a} \qquad (9)$$

a constant quantity: this is the greatest value that E O can p attain.

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* This equation is obtained in the following manner:—

$y' = \tan. \angle\, E\, a\, H \times (r + r \text{ los. } Y)$ but $\tan. \angle\, E\, a\, H = \frac{b}{2r}$

$\therefore y' = \frac{(1+\cos. Y)\,b}{2}$ as stated above.

* All the lines which are made use of in the foregoing investigat I think, be perfectly understood by those who have read the first ch Mr. Buck's Treatise on the Skew Arch.

ON BEAM AND DIRECT ACTION ENGINES.

"Non omnia possumus omnes."

Sir—Perceiving in your excellent journal a controversy of considerable importance, relative to the Beam and the Gorgon engine, I am induced to offer a few remarks thereon, placing them at your perfect disposal; and at the same time allow me, in mere good humour, to beg that we conduct our arguments in gentlemanly style, and avoid as much as possible cause for irritation, especially all harsh expressions not necessary to the elucidation of the subject. I allude to the opening paper of Vulcan, and reply of Mr. Pole, whose terms "misrepresentation and fallacy," I object to, especially in his first paragraph; he should allow your readers to draw their conclusions on these points and not prejudge the question.

As a dispassionate member of the profession, one not more wedded to the beam engine than other constructions, when such can be shown advantageous in their application, I pen the following remarks without prejudice, and will endeavour to carry out the principles recommended in my first observations, and to argue upon nothing but facts which have been published upon good authority, and which, I believe, cannot be disputed with fairness. After a careful perusal of both papers, and full consideration of their contents, I have come to the conclusion that Mr. Pole has not materially affected the position of Vulcan, or denied his chief points; why, it shall (with your permission) be my object to show. Vulcan's position appears to me to be this:—

1st. That the Gorgon engine is not new, as it regards the direct application of the power, and further that the credit due to the Messrs. Seaward is not equal to their claim, considering the chronology of its introduction.

2nd. That a saving of nearly one-half in space is not correct.

3rd. That a saving of 25 per cent. on the beam engine in weight is not founded on fact, and also that the weight given to the Government has been considerably exceeded.

4th. That the guaranteed consumption of fuel at 6½ lb. per horse per hour, is far from fact exhibited in practice.

With regard to the first point, Mr. Pole (am I right in supposing he writes "by authority"?) grants that the application of the "direct action" is not new, having been applied in the Tourist and United Kingdom, and the only question remaining is the comparative improvement of the Gorgon's on these, I may say at that time the only generally known (in this country) constructions of *direct engines*. Now, in my humble judgment, in considering this we should take into account the period at which they were brought forward, and make allowances for the infant state of marine engineering when Gutzmer designed his 50-horse engines subsequently placed in the Tourist, and that we should not omit to consider the great experience and practice we have all obtained from that period up to the year 1837, when the great light of the Gorgon engine burst in upon us.

Apart from the early period in which Gutzmer brought forward his direct engine, it should be recollected that the Tourist was a very small vessel—I say *was*, for she has been considerably lengthened—very shallow in her hold, quite flat in the bottom, and small draft of water, circumstances the very opposite of the Gorgon and Cyclops. The engines, in plan, were like Mr. Penn's oscillating engines, having *one* air pump and *one* condenser, the former wrought by a *cranked shaft;* so far Vulcan is right, for I feel assured Mr. Pole does not suppose the similarity was assumed, in workmanship or proportion. The stroke was 3 feet, and cylinder 40 inches, and the connecting rods were 2 feet 9 inches long,—less than twice the crank. I apprehend little difference of opinion will exist as to the cause of their imperfect action. It may be asked, why was this? I answer, Gutzmer had no alternative, other than making his wheel much too large for the stroke, and had he even put aside this objection, he must have brought his shaft on deck, which, *in those times*, would have raised a host of prejudices, and somewhat risked the insurance of the vessel. He had to contend with imperfect machinery, bad lathes and tools, and men unacquainted with their work, and many other things too numerous to mention, but too well known to projectors of olden time. It is not too much to say that the principal of these difficulties have been overcome for some years. Thanks to the late Mr. Maudslay, to Nasmyth, to Whitworth and others, we have arrived at a wondrous perfection in the executive department. I am almost tempted to say, the difficulty now lies not in the *execution*, but in the *invention*. How many schemers can tell a contrary tale!

Possessing these views, in conjunction with Vulcan, I cannot give to the revivifiers of a dormant scheme any credit of "conception or invention"; but that some merit is undoubtedly theirs, let us see how far it goes.

The Tourist was a small vessel of 300 tons, 23 feet beam, and 14 feet depth in hold; draft (loaded for the voyage), about 8 feet 6 inches, or 9 feet. Compare this with the Gorgon, a ship of 1050 tons—37 feet beam, 23 *feet depth in hold*, draft about 15 feet. Let us transpose the cases, and suppose Gutzmer to have flourished now and Seaward then: is it not reasonable to suppose that the acute Scotchman, possessing all the knowledge of modern improvements, would have carried out his principle in a very different manner? It should be recollected that large "men-of-war" steamers were not then thought of, and also that the "direct principle" is not, and never can be applied to vessels with a small draught of water, with any useful effect: so far, we are where Gutzmer left us. Powerful steamers are emanations of modern ingenuity, and it does not follow but that Gutzmer would have made his principle as "efficient and applicable on a large scale" as the Messrs. Seaward, had the circumstances of the times been in his favour.

There is another point in which I wish this question to be viewed. Any claim as to the "direct principle" having been conceded, it only remains to show how far there is *originality* in the *arrangement* or mechanical adaptation of the Gorgon engine, and I think I shall be enabled to show that this belongs, equally with the "direct principle," to a time antecedent to the Seawardian age.

Those of your readers who possess a copy of Gregory's Mechanics are referred to plate 23, fig. 10, and to the letter-press, vol. ii, p. 85, "Parallel Motion." In the former they will see an exact delineation of the Gorgon engine, and in the latter the worthy Professor informs us, after a full exposition of the principle, "that this motion, as well as fig. 8 (the common bridle motion) were devised by Mr. William Dryden, a mechanic, whose ingenuity needs not our encomium." p. 286, art. 3. Now, I am not prepared to say when Dryden invented it, but this is certain, that it was antecedent to Gutzmer, for *he* copied the motion No. 8 (the bridle motion) in the Tourist's engines, and by a curious coincidence his other invention was adopted in the Gorgon engine. The merit due to the Messrs. Seaward is that of "adapters"; to that they are justly entitled; they have shown great tact and judgment therein.

In criticising Vulcan's remarks upon the dimensions of the Gorgon engine, I scarcely think Mr. Pole is fair in putting forth a small table of the *lengths of engine-rooms*, as a criterion of space occupied, although his statement is perfectly correct. It is well known in the profession, that the engineer is not always consulted as to the distance between his bulkheads. It is often increased to make room for stores, duplicates, accommodation for engineers, &c. Sometimes the distance is increased by the shipwright, by caprice of the engineer, who does not wish to be "cramped" in manipulating his engine. We may also say, in large men-of-war it is not advisable to concentrate such great weights, but to spread them as much as is consistent with the accommodation of the crew, and the purposes of war. To my personal knowledge, this feeling has lengthened many engine-rooms several feet. In private trading vessels, I grant, the machinery should be as compact as possible, passenger accommodation and hold being of first-rate importance.

Now, in Mr. Pole's table, the vessels having *beam engines* are Hydra, Medea, and Vivid, the engine-rooms of Hydra and Gorgon being of equal length, viz. 62 feet, that of the Medea 60 feet; and it should be recollected that these vessels were fitted without the smallest idea of competition in this respect. Had it been so, I have no hesitation in saying that that of Hydra could have been reduced four feet without the slightest inconvenience; and Medea in the same proportion. Those of your readers who know the vessels are aware this is not mere assertion. But I will endeavour to show that the engines of the Hydra might be increased to 160 horses each (now 110), *without any increase of space;* and more, that a *beam engine* of the Gorgon's proportions may be constructed to occupy space as shown in Vulcan's diagram, and to weigh (with water in boiler) not more than 300 tons.

Having, therefore, I hope, explained why we should not take length of engine-rooms as conclusive evidence of excellence, we must recur to Vulcan's original position, and take the *bare* space occupied by the engine, especially as Mr. Pole has thrown aside all other portions of the machinery: on that very ground I am prepared to meet him.

First, I will show that the engines of the Medea and Hydra may be extended to 160 horses, without longitudinal increase of space in the latter, and a slight lateral increase in the former. The Hydra's engines are 110 horses each; cylinders 55⅝ in. diameter, and 5 feet stroke; length between centres of cylinder and shaft 15 feet, or 3 times the stroke. I believe this to be Boulton and Watt's usual practice, exceeding in this particular most other makers, (Maudslays, for instance,) and may here observe Mr. Pole appears to have overlooked Vulcan's statement, that he took Mr. Watt's data to prevent cavil, and see his computation of Gorgon power, namely, an assumed pressure of "seven pounds," and 33,000lb. lifted one foot. My calculations are made on the same basis. Referring to Weale's Tredgold, vol. ii, plates 33 and 34, engines of the Nile, (being exactly similar to the Hydra's,) plate 34 on the plan, shows the distance between the *ends of the main levers* to be 6 *feet* 4 *inches*, consequently there is room for a cylinder of that dimension over the flanges. Taking Mr. Watt's data, a 5-feet stroke should make 21½ strokes per minute, or 215 feet. This at 33,000 lb. is equal to a 67-inch cylinder to produce 160 horses, and if we allow 4 inches each side for the joints and flanges, we have 67+8=75=6 ft. 3, or an ample clearance of half an inch on each side. Plate 33 is a longitudinal section of the engine, and its extreme length from steam pipe flanch to fore end of engine frame is 23 feet 6 inches, its extreme width over the main gudgeons being 8 feet 3 inches only; and be it observed, this length includes an extended head stock framing, which (with all respect be it spoken,) I cannot conceive necessary, at least to so great an extent; but there it is, and as I wish to adhere to facts, what have we?—The Hydra's beam engine of 160 horses, requiring 23 feet 6 inches in length, and 8 feet 3 inches in breadth; the Gorgon engine of 160 horses, requiring 20 feet 6 inches in length, and 7 feet 10 inches in breadth—a saving of 3 feet on 23 feet 6 inches, or about one-eighth! I must call on Mr. Pole to show how this agrees with the first item of the Gorgon advantage, as quoted by himself from the pamphlet, viz. that the saving in space is very nearly one-half.

It may be said such an engine has not been made, and is merely hypothetical. I apprehend one thing only is necessary to produce it —an order.* And here I beg to maintain, the question is between the beam and Gorgon engine, and we have not only to prove what *has* been done, but what *can* be done, on the principle of the former. Let us take the Medea, by Maudslay. I refer your readers to Tredgold, plates 37 and 38. The former is a plan of the engines of the Phœnix (same as the Medea); the distance between the main levers is 5 feet 10 inches. Here we require a *lateral* extension to 6 feet 4 inches, as in the Hydra, to make room for a cylinder of 67 inches. This done, the Medea's engine is 7 *feet* 9 *inches over all athwart*, or one inch less than the Gorgon! Plate 38 is a longitudinal view of the same; the length of the engine is, as it regards space occupied, only 19 feet, but as in the Hydra, I'll take in the additional piece of frame, and call it 21 feet 6 inches, and what have we?—Medea beam engine, requiring 21 feet 6 inches in length, and 7 feet 9 inches in breadth; the Gorgon engine, requiring 20 feet 6 inches in length, and 7 feet 10 inches in breath—a saving by the latter of $\frac{1}{21}$ part in length, and an *increase* in breadth of one inch. Sir, let your readers examine and judge for themselves.

Having, I hope, shown that what may be called engines of some standing can be increased to 320 horses without additional space, I now fulfil my promise, to explain that engines having the same stroke as the Gorgon, viz. 5 feet 6 inches, may be made under these restrictions. In fact, I shall do no more than prove the correctness of Vulcan's "*sketch*." And here, Sir, I have recourse to the useful table published in your April number, viz. the proportions used by Maudslay, Son, and Field. You state their 100 horse 5-feet stroke is 14 feet 2¾ inches from centre of cylinder to centre of crank (see table, the 42nd and 43rd line). Having 6 inches more stroke, say 5 feet 6 inches, we will take this proportion, and find the same distance to be 15 feet 6 inches as near as may be. By Mr. Watt's formula a stroke of 5 feet 6 inches should make 20·136 strokes, or say 221½ feet per minute, to produce a power of 160 horses. At this speed we require a cylinder of 66 inches, the same as in the Gorgon: then for a beam engine on these proportions, we have—

	ft.	in.
Distance from crank to centre of cylinder	15	6
Half diam. of cylinder, plus flanges, joints, &c.=33+9=	3	6
Half projection of headstock: in this we take Messrs. Seawards' own practice, as in the Mœgara, taking proportion as length of crank, the true guide. The Mœgara's stroke is 4 feet 3 inches; width of headstock 4 feet 3 inches. (See Tredgold, plate 49.) In this case the stroke is 5 feet 6 inches: take 5 feet 6 inches÷2=	2	9
For the whole length of the engine	21	9

The *width* of such an engine would be as that of the Hydra, viz. 8 feet 3 inches. Thus, what have we here?—A beam engine, as the Gorgon, 21 feet 9 inches in length and 8 feet 3 inches in breadth; Gorgon engine 20 feet 6 inches in length, and 7 feet 10 inches in breadth—a saving of 15 inches upon 21 feet 9 inches, or just one-seventeenth part, and in breadth a saving of 5 inches upon 8 feet 3 inches, or about one-nineteenth part. Does not this call for explanation? I have not done yet, but fear being prolix, although I hope you will bear with me, as it is of great importance to the profession that this matter should be set straight.

Let your readers consult Tredgold, plate 49, being a longitudinal section of the Mœgara's engines. They are stated to be *seventy* horses, having a 44-inch cylinder, and 4 feet 3 inches stroke; according to Mr. Watt, this should travel 206 feet per minute, giving a power of 66 horses. Now this engine occupies 17 feet 6 inches in length for this small power; and if the Gorgon engine is compared with such beam engines, perhaps a better case might be made; but that, I humbly submit, is not the point in dispute.

Having given your readers comparisons of Boulton and Watt's and Maudslays' practice, let us go north, and show what our Scotch friends can do. Let them look at Tredgold, p. 41—a section of the Don Juan's engines, by Claud, Girdwood and Co. (I am now speaking of space only). This is an engine of 6 feet stroke, and 68-inch cylinder, at 7 lb. equal to a power of 176 horses×2=352 horses, or 32 more than Gorgon; and what have we here?—

	ft.	in.
A Clyde beam engine, over all	23	3
Gorgon engine	20	6

—A saving of 2 feet 9 inches upon 23 feet 3 inches, or about one-eighth. No plan of this engine is given, so I cannot compare as it regards lateral space, be it observed this scheme is like Vulcan's sketch, particularly in the way the longitudinal pressure of the shaft is resisted by large deck beams; and is there any reason why this should not answer in a beam as well as in a Gorgon engine? Should it not even be better from the greater length of the connecting rod?

In concluding the subject of *space*, I will draw attention to the facts that I have shown:—

1. That the Hydra's and Medea's engines may be increased to 320 horses, without material additional space.
2. That a beam engine of the Gorgon's proportions may be constructed as sketched by Vulcan.
3. That the Don Juan's engines are 32 horses larger than the Gorgon's, and only 23 feet 3 inches long.
4. That the saving in No. 1 is about one-twelfth, in No. 2 one-seventeenth, and in No. 3 about one-eighth, this latter being of larger power.

Mr. Pole assumes an argument in favour of the Gorgon engine, upon the number made by the Messrs. Seaward. Let me repeat Vulcan's assertion, that with two foreign exceptions, the "British Government is the *only* patron of the Gorgon engine." No commercial man connected with steam navigation will look at them.

I do not think Vulcan *political* in reflecting on the judgment of navy engineers: they are notoriously behind, and have great lee way to gain. Mr. Pole will recollect that, not long ago, we had a highly favourable report on Hall's condensers; that thousands were expended on Morgan's wheels; still the first invention did not extend beyond the Mœgara, the latter is now exploded; may we not suppose a similar fate awaits the Gorgon engine? I think Vulcan's prophecy most reasonable and probable. It may be said, the Government are the persons to make experiments. True; but should they not be guided by discrimination and judgment in the selection of subjects?

But other firms are making "direct engines." Government say "We will have no other: what are they to do? They must comply, or lose royal favour, shut up their shops, or find work for their people. Is the course difficult to decide? 'Tis what is vulgarly called "Hobson's choice." But if we are to have "direct engines," let us have them in a shape that offers compensation for their acknowledged disadvantage. If credit is to be given to the Messrs. Seaward for a reduction of one-eighth, or one-twelfth, or one-seventeenth, what amount of admiration is due to Maudslay, to Boulton and Watt, who, in the Devastation and Virago, have annihilated space to one-half that of the Gorgon engine! Could those gentlemen have stooped to such species of advertisement, with what propriety could they have published a pamphlet, and with all the "pomp and circumstance" of success, have said—1st. "A great saving *(nearly one-half)* of the space usually occupied by the engine in the vessel."

I now advert to the important subject of the weight of marine engines. Vulcan states "the assumed weight of the Gorgon's machinery was 257 tons, and that it really weighed 298¾ tons." This has not been contradicted, and I presume it to be correct, as great care was taken; Government appointed a special officer to see each portion weighed. Now I am fully aware of the difficulty in assuming weights of machinery, especially that of a new design, and do not think much of the Surveyor of the Navy's annoyance at finding some 40 tons more on board than he had displacement for; but that is not the point of difference. It is, what proportion does this 298¾ tons bear to the weight of a pair of beam engines of 320 horse power?

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* Since writing this, I have been credibly informed that a pair of beam engines of this power, or nearly so, are constructing by Boulton and Watt.

Much has been lately said concerning the great weight, bad proportions, and large consumption of coal, of the Clyde engines; with what truth, it is not now my intention to inquire, but their makers can bear it well, when they recollect, before they became of sufficient importance to be considered as rivals, that the same charge was brought against Boulton and Watt. Mr. Pole, supposing Vulcan to be of "Bromielaw" origin, gives them a very sly hit. He says "Four pairs of 280 horse power, made in Scotland, exceeded the assumed weight by 60 tons each pair." If so, it only proves that they (the Scotch) sinned in a greater degree than the Canal Iron Works, in the exact proportion of 280 to 60, as 320 is to 40, nothing more. Are we to qualify our own errors, by exaggerating those of others? No, no, the Gorgon engine is a Thames production: let us try it by its *compeers*. Here I must accuse Mr. Pole of a quibble. He throws aside all the machinery but the ENGINE, as I observed before; as it regarded *space*, this is a perfectly fair comparison, but not so as it regards the weight. He has shown the engine alone to have exceeded its estimate by two tons only. True; but engines are scarcely complete without paddle-wheels. To avoid any misunderstanding as to the shafts and other portions being put to debit or credit, let us take them both together, and we have—weight given, 145 tons; real weight 163; a difference of 18 tons. Here lies the quibble: it must be evident, even to the unprofessional reader, that a saving in one portion of a ship's machinery, if counteracted by increased weight in another, is of small use in result, and that in comparisons of this sort, it is proper only to take the *total weight complete*. This I do! Vulcan states the Gorgon's weight to be 298¾ tons, and he has not been *directly* contradicted. In the table, p. 133, Mr. Pole puts it at 280 tons. Had we not better call upon Vulcan to produce his promised "official" report upon this subject? Apropos of this very admission, that the Gorgon engine is 0·88 of a nominal horse per ton, and that beam engines are about 1·00 ton per horse per hour; the difference here is just 0·12, or less than one-eighth, and the pamphlet, see art. 2, promises a saving of 25 per cent., or one-fourth. May not the Messrs. Seaward say, "Save us from our friends?"

This last statement of Mr. Pole is in accordance with my own practice. I have now before me a list of 52 pairs of beam engines, made by an eminent firm, averaging from 300 down to 40 horses collectively. The smaller power, say to 2, 60 horse, certainly are not more than ·9 of a ton per horse, not being encumbered with coal boxes, a rather formidable affair in very large vessels. The larger powers generally having this additional weight average one ton per horse: in one or two cases this was exceeded, in others not reached, depending on the *depth* of the vessel, and other data not necessary to be enumerated. And these weights include engines, paddle-wheels, boiler and apparatus, coal boxes, water, duplicates, and tools, &c.—in fact, complete for service.

M. Pole states the weight of the Monarch's engines (the Nile's were exactly similar,) at 270 tons. I take this for granted, as I am not able to obtain any corroboration. Now I have already shown, by reference to Tredgold, that these engines may be increased to 320 horses, without increase in space, and by the substitution of a single cylinder 67 inches in diameter for a double or jacketed one 55⅝ inches in diameter, without any material increase in weight. Taking a beam engine at one ton per horse, we have, 320 tons $-270=50$ tons surplus, to be expended in strengthening the working parts if necessary, and in increasing the boiler to the required power. I have shown the Medea may be increased to 320 in like manner. Her weight is 240 tons, and $320-240=80$ tons surplus for purposes above stated. I have no hesitation in saying it is very ample, and that an engine 5 ft. 6 in. stroke, as sketched by Vulcan, could be constructed to weigh no more than 300 tons.*

The last item is the consumption of fuel. I admire Mr. Pole's wit more than his judgment, in bringing a heavy charge against Vulcan—that of "gratuitous fabrication." He should have been careful of his facts here, as it vitiates a somewhat well-written paper. Vulcan not only speaks of the pamphlet, but also "some of the published statements and assumed facts;" see his second paragraph, certainly a very temperate one. If it can be shown that the Messrs. Seaward *have published the fact, that their engines require* 6½ lb. only per horse per hour, I apprehend Vulcan's error in having quoted it *from* the pamplet instead of from other papers, will be considered venial. This I will do.

I have now before me, (and they are sent for your inspection) five publications, hand-bills, call them what you will, the three first extolling "Mr. Samuel Seaward's patent expansion slide valves and salt detector," the fourth a lithograph copy of letters from the commander and engineer of the Gorgon, detailing her wonderful and unequalled performances on the north coast of Spain, and the last is a sort of compendium of the foregoing, as well as a species of "olla podrida" of the productions of the Canal Iron Works. It is an extensive affair, epistolary in its form, and therefore certainly *not* intended for private circulation, so that I commit no breach of good manners in bringing it before you.

In this last production it is worthy of note, that the claim of "saving in weight" is reduced from one-fourth to one-fifth—an improvement in the right direction, most surely. And the 4th article says "a great saving in the consumption of fuel"; and, further on, (I copy the whole paragraph,) "we guarantee that the consumption of fuel in our marine engines, constructed upon our improved system (that is, the Gorgon engines, for nothing else is hinted at,) shall be UNDER SIX POUNDS of good coal per horse per hour, the engines working at their full efficient force, with the steam passage open at least four-fifth of the entire stroke of the piston."

Mr. Pole takes a common-sense view of the question, when observing there is nothing in the "direct system" alone which could produce a saving in coals. But the claim of *under six pounds* is staggering in any kind of engine, and being placed alongside other matter of an apocryphal nature, demands notice. If the saving is not in the engine, it may be in the boiler, or probably in the felt or jacketing. Let us give credit where it is due.

If there is any irrelevancy in the introduction of this "fuel question," it cannot be ascribed to Vulcan, but to the proprietors of the Canal Iron Works, who, in vending their Gorgon engine, have claimed for it properties which it does not possess. Is the saving in the boiler? Has it, from its scientific proportions and construction, greater evaporating powers than those of other manufacturers? To this I answer, no, so far as my experience and practice will allow me to discover. I do not say they are copied therefrom, but they have the same arrangement of flue as those made by Maudslay some years previously or the Dee, Messenger, Phœnix, Salamander, &c., and I should say were capable of evaporating at atmospheric pressure about 15 cubic feet of water with a cwt. of good coal, that is, about 8¼ lb. of water with a pound of coal. The grate surface is small, being 165·6 square feet, a little more than half a foot per horse, say 0·52, and I make the total surface (not taking the *bottoms* of flues) to be about 3388 square feet, or 10·5 per horse.

Your professional readers will see nothing very new in all this; and if the facts are disputed, I am prepared to send you authenticated drawings, not only of the boilers of the Gorgon, but those of the Dee and Messenger, that they and you may draw their own inferences. The clothing only remains. I do not know of any experimental knowledge on this head on which we can rely, to show the ratio of saving by its adoption, but hope at a future time to lay such before you.

The Messrs. Seaward, in the aforesaid "olla podrida," say "The great saving we are enabled to make in the consumption of fuel we accomplish in part by OUR NEW MODE of clothing or jacketing the boilers, cylinders, &c." "OUR new mode"! What is it, and in what does it differ from that which has been adopted by other engineers for years before the Seawardian era? Surely all credit on this head is due to "Watt," who was, of all others, the most forward in recommending this plan. True, he used sawdust, and found it to answer excellently as a non-conductor. I am old enough to remember that, so far back as 1817, felting the boiler was adopted. Some of your readers probably recollect seeing in the autumn of that year a small vessel called the "Caledonia," which was purchased by the *present* Mr. Watt, and in which he placed a pair of 14 horse engines, and subsequently ascended the Rhine as far ar Coblenz, to show the natives what steam could do. The boiler of this vessel was *felted*, aye, and carried out to a great extent. The front of it was covered with *block tin*. I cannot tell the amount of saving in coal, but the comfort of the officers and crew was materially increased. It is unnecessary to follow this subject further, to show the antiquity of the practice of "clothing." I therefore humbly submit that the words "our new mode" should be expunged from this advertisement, or that the Messrs. Seaward explain unto us on what grounds they put it forth.

I cannot omit to notice that which follows the foregoing quotation. Speaking of the reduced consumption, they say we are enabled "more particularly to accomplish this by a most valuable improvement, for which we have letters patent," that is, "causing the spent steam from the cylinder, before it enters the condenser, to pass through [illegible] out its heat to the feed water." This I conceive [illegible] improvement as could well be devised [illegible] great credit for the same.

But taking all the claimed [illegible] the five publications, togeth [illegible] see any reason to conclude [illegible] sumption as *under six pounds*. The onus lies with the Messrs. Seaward, to prove this upon scientific and practical data; and until they do so, I must conclude, with Vulcan, that they have been carried away by enthusiasm.

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* Would Mr. Alexander Gordon favour us with the weight of the Don Juan's engines?

The following data and dimensions on which the Gorgon was constructed, may be relied on:—

DIMENSIONS.	ft.	in.
Length between perpendiculars	178	0
Keel for tonnage	152	3
Moulded breadth	36	4
Extreme ditto	37	6
Depth in hold	23	0
Tonnage . . . . . 1108.		

DATA.	
Weight of masts and rigging	25 tons.
Anchors and chain	50 "
1000 men	133 "
Engines and water	270 "
Coals	300 "
Hull	630 "
Provisions and stores	78 "
Total	1486

Displacement at load line . . . 1412 tons.
Load line 12 tons to an inch immersion.

I give you this, that I may put a few questions to Mr. Pole. He says "the speed of the Gorgon's engines, with 400 tons of coal, is 19 strokes per minute; with 200 tons, 21 strokes per minute." One or the other appears incorrect; thus $420-200=220$ tons difference. The Gorgon at her load line is 12 tons per inch; we have $\frac{220}{12}=18\frac{1}{4}$ inches decreased draught, with the 200 tons on board. It would be more than this, for at 18 inches below her load line, she is probably not more than 10½ or 11 tons per inch. But say 18 inches; does Mr. Pole assert that the paddle wheel (26 feet 10 inches working diameter by 7 feet 2 inches long,) relieved of 18 inches dip, would only make a difference of *two strokes* in the engines? Again, with reference to the Styx, he says "she had 260 tons of coal on board, and went 21 strokes." Where did she get them? I allude to experiment, 6th May, 1841 (see, as referred by you, p. 210, vol. iv.), on which occasion *she started* from the Canal Iron Works; and I believe the Government are not in the habit of sending coals to their ships away from the dockyards, especially so large a quantity as 260 tons. With regard to the speed of the engines, you, Sir, setttle that—it was 17 strokes; so we must have these questions answered before we finally convict Vulcan of falsehood.

By the bye, allow me to lecture yourself for two very important errors in the paragraph p. 210, vol. iv. First, you say the Styx's engines are 560 horse power, cylinder 62 inches, 5 feet 3 inches stroke. According to Mr. Watt, this gives 140 horses each engine, or 280 only for both. Secondly, you say the Styx is fitted with Mr. Seaward's *patent* engines. This controversy has already shown there is nothing of the sort. There are other points which I would wish to go into, especially relating to the evaporative power of the boilers, and their incapability of producing steam equal to the supply of cylinders of 66-inch diameter, 5 feet 6 inches stroke, and 20 strokes per minute, *at a consumption of "under six pounds"*: but fear I have already transgressed too much on your space; I therefore reserve this for a future communication.

I refer to the statement of Vulcan that one-third of the power is absorbed by the friction of the piston rod, merely to say that I do not understand it. Verily it appears in its present shape to be nonsense, and is either a misprint, or error in expression. Let Vulcan explain; and perhaps in the mean time Mr. Pole will give us *his* version of the subject.

I have heard, and I have read, not only in the *Journal*, but in a talented Glasgow contemporary, "dark and mysterious hints" of collusion between public officers and private establishments. How far this is correct I am not prepared to say, but hope, for the honour of the profession, that it is not true. However, it behoves the principals of all our large establishments to come forward, and remove this aspersion upon their honour. "Competition" is a glorious thing for the advancement of both theoretical and practical science; let us have it to repletion, but *let that competition be fair and honest*. Possessing, I am proud to say, a somewhat extensive acquaintance among the members of the profession, I am sure there *is not one* but would emphatically agree with me in this sentiment; but I am sure they will equally "grieve" with me at the following:—The *Mechanic's Mag.*, (No. 974), has a continuation of the *olla podrida* species of advertisement. It states "the Admiralty have given instructions to build a large frigate, the *Penelope*, of 650 horse-power—that it is the proposition of Mr. John Edye, and that the commission for building the engines *has been given* to the inventors of the *Gorgon* plan, the Messrs. Seaward and Co."

Those who know Mr. Edye are well aware that his talents and accomplishments are great and various, and that the natural modesty of his disposition, added to the dignity of his official situation, would not allow him willingly to have his name thus brought forward for others' uses. But has the executive of the Admiralty acted with their usual fairness in this case? They have given unto the Messrs. Seaward this large order to the amount of perhaps £25,000, *without consulting any other establishment*—is this fair or honest? Is it a proper compliment to the profession generally, when it is known that others have improved upon what is termed the *Gorgon* engine even to a moiety, as it regards space. To what are we to ascribe this partiality? is a question I decline to answer.

I am, Sir,
Your's very truly,
London, 12th April, 1842. PERSEUS.

SIR—I should not again have troubled your readers with any further remarks on "Direct and Beam Action Engines," had not an article appeared in your April number under the signature of Wm. Pole, in which an investigation of the relative amounts of friction in the two descriptions of engines is imperiously and confidently demanded.

I am glad of the opportunity thus afforded me of correcting an ambiguity in one of the sentences upon that subject, which unfortunately escaped my notice until it appeared in print in your January number. It might, indeed, seem that I had wished to convey the impression that the friction on the parallel motion of the Gorgon engine equalled one-third of the power exerted—but far was it from my intention to express so palpable an absurdity: when comparing the amount of friction upon the parallel motion in the beam and direct engine, I might well call it *relatively* enormous in the latter case, "upon those parts the *strain on which*, caused by the short connecting rod, is so great as to equal one-third of the power of the engine passing through them to compel the piston rod to move in a vertical line"; the uncertainty as to my meaning arising from the accidental omission of the words "the *strain on which*," I much regret, as it has caused me thus in explanation to trespass on your valuable space, and gave your correspondent an opportunity which, in his desperation, he seized upon with avidity, of proclaiming a transient triumph.

That the lateral strain does amount to one-third of the power exerted is simply shown:

Let a be the angle which the connecting rod makes with the vertical, and let P represent the effective force on the piston; then,

P secant $a =$ strain along the connecting rod,

P tangent $a =$ the horizontal thrust; and when the connecting rod is three times the length of the crank, the greatest value of $a = 19° 28'$, in which case the lateral thrust equals P 3534; this pressure has to be sustained by the parallel motion or guides whichever may be adopted, and in practice causes great wear and tear on those parts, nor has any combination been found effectually to resist the strain for a length of time.

Having already far exceeded the limits between which I had hoped to have confined my remarks, I shall defer, for the present, making any allusion to the subtleties and the assumed knowledge of facts with which Wm. Pole has filled his communication, but shall not fail to do so on an early occasion, unless, indeed, some of your readers, with a readier pen and more time at their disposal than I have, should be roused by indignation to expose the fallacies with which that paper abounds.

Sir, I am,
London, 19th April. Yours, obediently,
VULCAN.

INLAID MARBLES.—A beautiful mode of ornamenting marbles has recently been brought into use in Paris. It consists in etching, by acids, deeply into the marble, various designs upon a properly prepared bituminous ground. When the corrosion has gone sufficiently deep, the cavities are filled up with hard coloured wax, prepared so as to take a polish equal to that of the marble when cleaned off. Drawings thus made on black marble, and filled in with scarlet wax, after the manner of Etruscan, and certain Egyptian designs, are said to have a very noble effect, and are applied to tables, panelling, stoves, &c.—*Repertory of Patent Inventions.*

ON FRESCO PAINTING.

BY JOSEPH SEVERN, OF ROME.

(Read before the Royal Institute of British Architects, on Monday, March 14, 1842.*

I CONFESS myself almost an enthusiast on the subject of fresco painting, having had the singular happiness to pass half my life in Italy in the midst of the finest fresco works, and having enjoyed the friendship of all those modern German artists who have revived and perfected this manly and useful style of art, and created a classical city in Germany. I am therefore sanguine as to the great probability of success attending the proposed introduction of this *architectural* style of painting, although new and strange to the English artist, as well as the people; believing that, if successful, it will be the means of introducing and establishing in England the grand style of historical art hitherto unknown here. If this beautiful style of painting be successfully introduced here, it will be more indebted to the helping hand of British architects than of British painters, for it can only be understood and felt by those who have seen with their own eyes the magic of its power in its great Italian examples. Now architects, more than painters, have visited the places where those wonders of fresco art still live triumphant, after the lapse of three and four centuries, defying the ravages of time, and almost of man (the greater destroyer of the two); and in studying the principles of architecture in those classic regions, the English architects have involuntarily taken fresco painting as a branch of their own noble pursuit.

I began by calling Fresco "Architectural Painting," because it is on this ground that its advantages are most evident, and it is on this ground we have to consider it—indeed, strictly speaking, fresco is purely architectural. I will not enter into any details about the material, which has been so much discussed, and is now so well known; but I will endeavour to explain and contrast the theory of the fresco art in its principles and object, as compared with oil-painting—the great difference betwixt the one and the other—and the different ways of acquiring the former.

Oil painting is more applicable to the other purposes of art, particularly moveable art. Its excellence is seen in cabinet pictures of domestic scenes, portraits, and the like. It has force and delicacy in history and landscape, and its finest specimens have deservedly won the admiration of all times; but it is in reference to architecture that we are now to judge it, and I say that fresco painting alone is adapted to this purpose. The shining surface is an insuperable objection to oil, as it requires particular and concealed lights to get the general effect, or rather the whole effect of the picture from every part of the room. Now this, as regards large works, such as national history demands, is impossible, since no construction of building, not intended as a picture gallery, can possibly admit of it. And even in picture galleries, how difficult, how rare it is (although they may be actually built for the purpose) to see the pictures well and entire. I need only mention the National Gallery, where the finest work of Italian art in England, the Sebastiano del Piombo, cannot be seen entire from any part of the room at any hour of the day; and I am sure I need not point out how necessary it is to the true effect and understanding of a large historical work that it should be seen entire at the first glance; and how completely the dodging about to find a spot whence the picture can be well seen, frustrates the aim of the painter. This does not apply to small pictures, which can be well seen anywhere; I am speaking only of large works, such as national works are and must always be. At Venice, three of Titian's most celebrated works are comparatively invisible, for these reasons. My remark applies generally to oil pictures in churches: so much so that in Italy they are beginning to remove the principal works to public galleries, constructed for the sole purpose of exhibiting pictures; thus, as you will at once perceive, destroying the local object of the paintings, either as to their moral or religious purpose, and even the architectural decorations for which those paintings were formed. This is the case with the "Transfiguration," which no doubt would interest us more in the actual place for which it was painted, if it could be seen there; and the same may be said of most of the celebrated altar-pieces. The oil-painted staircase of the British Museum you have all seen, or rather *nobody* has seen, as it never could have been seen, owing to its dazzling glare, even by the painter himself when he did it:—but you know enough of these examples for my purpose, which is, to show the immediate connexion of architecture and fresco painting.

As regards light, fresco is seen entire in any situation and by any light; even candle-light, which, I think, perhaps shows it best. I remember seeing the Carracci frescos, at Rome, during a ball, when I was struck by their increased beauty and power, owing to the warm light; even a dim or diminished light does not destroy their effect, for fresco pictures are always well seen, with any kind of window, or even without any positive light. It must have been for this reason that Raffaello adopted fresco in the Vatican, after he had made experiments in oil; for the rooms are so ill lighted that oil pictures could never have been seen at all, and it is surprising to find such fine works in such a place. Three sides of the rooms are illuminated merely by the reflected light from the great wall of the Sistine Chapel, yet this beautiful and luminous materal of fresco is so brilliant in itself that the pictures are well seen. Nine of them were painted without a ray of real light, and have always been seen in the same way. I think this a very important consideration, for, as we have but a diminished light at any time, it is most necessary to adopt a manner of painting suited to it, which can be seen at all times. Such is the power of fresco, and such, as regards light, makes it preferable to oil for all our purposes.

The fact of Venetian painting, as regards the decorations of architecture, being in oil, I consider to have arisen entirely from the singular locality of that beautiful city. It was soon discovered (as Vasari mentions in the Life of Giorgione), that fresco was but a perishable thing exposed to the sirocco and the sea air, for the frescos of Giorgione in a few years were destroyed. This, I have no doubt, led to the adoption of oil-painting there for architectural decoration, as it was found to be more durable. But this argument applies only to Venice, for the other great Italian cities are adorned with fresco; nor can it be urged in favour of oil being employed here, as the localities of London and Venice are wholly different. There are frescos by Titian at Padua well preserved; yet at so short a distance as Venice you find nothing of the kind, save the skeletons of Giorgione's works on the fronts of houses. This may be a reason for not employing fresco in the open air in England, for, as it does not stand well in Italy, it may be presumed that here it will not stand at all.

But the great objection to the employment of fresco in this country is on the ground of colour and effect, for it is generally confounded with scene-painting; that the Cartoons of Raffaello are the same as his frescos; and that the colour and effect of one and the other would never do for English eyes. Now this mistake is extraordinary and unpardonable, for, as fresco is done on the wet plaster, imbibing and incorporating transparent colours, as well as opaque, (something similar to water-colour painting when body colour is used on the lights,) producing a richness of tone, surface, and touch, always equal, and sometimes superior, to oil-colours; so it bears little or no comparison or relation to distemper-painting, which is done on a dry ground, and does not admit of any richness of colour. This will be clearly understood by those who have had the good fortune to see Raffaello's and Guido's frescos at Rome, which, for colour, are exquisitely beautiful, and even powerful in all the fascinations of this part of the art, presenting to us still greater varieties than oil painting can pretend to; excelling in all the delicate effects of atmosphere, from the gorgeous daylight, the air of which you seem to breathe in a fresco picture, down to the silvery flitting charm of twilight. In these particulars it reminds us of English water-colour effects. Then I should mention the magnificence of fresco landscape, and of landscape backgrounds, particularly by Domenichino, in which not only the characters, but the movements of trees are always rendered in a way which I have rarely seen in oil colours. And when we consider the ease with which the effects of atmosphere are produced in fresco, and the difficulty and immense labour of producing the like in oil—when I tell you of the advantages even of the dark grey wet ground in fresco, drying out light, and producing so many beauties of aërial perspective in that actual drying, so much variety and transparency of colour, so much lightness and vivacity, so much of what the Italians call "light within"—the superiority of fresco cannot be doubted on the ground of colouring, as applied to architecture. Who does not remember the splendid colouring of Guido's "Aurora," at Rome?—colour so inimitable that, of hundreds of copies in oils, I have never seen one that gave an idea of the original. What of Titian's or Paul Veronese's is there to equal Raffaello's fresco of the Bolsena miracle, in truth of colours?—or the Heliodorus, was it ever surpassed?

If I have to speak of chiar-oscuro and its wonders, I should refer you to the frescos of Guercino, particularly at Piacenza, where are his finest specimens. The portions of his oil paintings which are black and monotonous, (the effect of time on his dark grounds,) in his frescos are transparent and lucid in the highest degree, with a power of shade which I consider superior to Rembrandt, inasmuch as it gives an extended light instead of a spot, while the masses of shade form the effects of the pictures. It must be considered that time has not changed the frescos, and that it is only in them we can understand Guercino as the Magician of Painting, which he is called by his contemporaries. Till I saw these Piacenza Frescos, I used to consider him as a "vile shade-hunter." Another great painter in chiar-oscuro, never understood in oils from his blackness, is Spagnuoletto, whose works in the church of St. Martino at Naples are amongst the most striking things in art. The same may be said of Raffaello's strong effects. In his oil pictures we see midnight shadows in noon-day, as in the "Transfiguration;" but in his frescos it is all truth and beauty, with power. The "Peter delivered from Prison," and the "Flight of Heliodorus," have the charms of Corregio and Rembrandt. Then I must remind you of the grandeur of colour and effect in Michael Angelo's frescos on the ceiling of the Sistine Chapel. What oil could ever have approached such things? When he said "that oil painting was only fit for women and children," he meant on account of the labour and difficulties of the material, compared with fresco. We are assured he performed this gigantic labour in twenty months, without the usual assistance of colour-grinders or plasterers, but alone with his own hand. There are on this ceiling fourteen figures, of at least forty feet in stature, and nearly five hundred figures, the least of which are double the size of life. While we regard this as the most extraordinary example of individual human power, we must consider that it was only in the simplicity and ease of the fresco material that Michael Angelo could have accomplished such a stupendous work. The preparation of oil colours, varnishes, &c. would alone have occupied the twenty months.

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* This paper we intended to have published in the last month's Journal, but through want of room we were obliged to postpone it to the present month; it has in the mean time appeared in the "Athenæum."

All these works I have cited to prove that the powers of fresco in colour and effect are wholly architectural, and when I remind you of their gigantic proportions, forming and assisting the grandeur of the architecture, I am sure the superiority of fresco must be apparent, as applied to buildings. Oil painting, applied in the same way, even with the advantage of good air and light, is always subject to change to a sickly yellow, like a person sinking into bad health, and losing all his natural colour: but fresco never loses its health and freshness; and if it is to decay at last, like all mortal things, it goes down with its own proper tints—it has a vigorous old age. Another thing I ought to mention is, that so many great artists who have now immortal names, condescended to inferior styles in the Vatican decorations: thus Giovanni da Udine painted the fruit and the flowers, animals, musical instruments, and so on, in a wonderful way; Polidoro did the beautiful chiar-oscuros; and Lucca della Robia executed the coloured tiles for the floors. All those great artists raised the things they undertook under Raffaello, whilst he himself seemed to raise the art when he worked in fresco; for if we consider oil painting up to the period of the Vatican frescos, that art seemed in its infancy. The space, the architecture inspired Raffello;—in what but fresco could his beautiful mind have expanded?—in what else could he have given us such a range of art, from the most sublime history down to ornaments of fruit, flowers, animals, and even pavements? Has he not given us a world of art in the Vatican? Have not those grand frescos given laws to the art? What is there like the "School of Athens," or the "Heliodorus," the "Parnassus," or the "Burning of Rome"? Such dramatic art had never been seen before, such compositions of figures and backgrounds, such colour and effect. And when it is considered that even the minor details on the ceilings and walls all belong to one grand epic invention on the subject of church empire, I think it must be seen that nothing we have in oil colours has so expanded the limits of painting, and made it the worthy sister of poetry. Can there be a doubt we owe all this to fresco?

I will now consider the great advantage of painting being united to architecture in this country through the medium of fresco; and I trust to show also why oil painting could never do the same, and that we can now only have the long-looked-for era of historical art—art, patronized not only by the State, but by the people at large.

It is impossible to look on the historical fresco painting of Italy, recording, as it does so powerfully, the valour and genius of the Italians, without thinking on England; and reflecting that, with a history more heroic, and with genius more useful, we have nothing of the kind in painting—no public works to remind us of our illustrious ancestors. The Italians adorned their public buildings in fresco, not only with the great events recorded in their national history, but every man recalled and recorded the illustrious deeds of his ancestors, whether public or private, which could confer honour on his name and family. This noble emulation continued from generation to generation; and we see, in the monuments which remain, worthy memorials of the triumphs of mind in civil arts as well as the triumphs of war. These now, in the fallen state of Italy, are all that remain to her of past glory, and it is this which interests the traveller at every step. Who does not remember the Colonna Palace at Rome?—the family now a name and nothing more, yet its former deeds are written there; the principal of which was the great battle of Lepanto. Hundreds of similar examples might be cited; and the influence of this system of beautiful decoration has extended even down to the cottage, however humble, where you always find some little elegancies to remind you that you are in Italy. It is but reasonable to hope, that when fresco painting shall have been introduced here, under the patronage of the State, it will extend itself in a like manner to the adornment of the houses of the nobility; not only in tracing there the great actions of their ancestors, which may bear comparison with those of any age or country, but in recording the great events of our own times, events which are moving and modifying the world. These are the true decorations of buildings, these are things to be proud of, and these we shall accomplish by the introduction of fresco painting. The oil portraits of our ancestors are all that remain to us, but fresco will pourtray their actions. When we reflect on the illustrious names, and the illustrious deeds connected with them, there seems no bounds to the field of fresco-painting.

This never could have been accomplished, or even projected, through the medium of oil painting, which, independent of the great cost, required such architectural sacrifices to exhibit it. On the other hand, distemper was too perishable and mean. Fresco will remedy all these evils, for its durability is great, and its expense but small. Then the facility with which it may be cleaned, and the ease with which it may be seen, even at night, are advantages which, I think, must insure its success. The grand Italian hall, decorated with fresco, is unknown here, save in the impossible attempts to imitate it in oil. For myself, I cannot but think that the want of fresco here, when we consider all the advantages of durability, light, cleanliness, and cheapness, must have been the cause why historic art has not risen and kept pace with those magnificent things for which England is celebrated all over the world. The English are a highly imaginative people, in their literature particularly; writers and readers go hand in hand, indulging for ever in the pleasures of the imagination; this extends to every thing, save painting. This limitation must arise from the want of power in the medium, and the consequent want of encouragement; for oil-painting has been too costly for its historical purposes, and, from its rareness, could never rise to sufficient rank to make it worth the while of State or people to assist the education of her artists in that most difficult branch of the art.

The ease and facility of fresco will obviate all this; the education of the painters must and will be improved by it. The necessity for grand composition and manly design, even on a simple cartoon, will, I fully expect, not only improve and raise the English painter till his natural capabilities are fully developed, but will fascinate him on to new and imaginative regions of art. This healthy power in his hands, what will he not do? what are the limits to a style of art, which has all the beauty, clearness, and lightness of water-colour, with the richness of oil, great dimensions and architectural powers? Were it alone for the advantages of design, it would be worth our while, as a school, to introduce it, that we might outface all the railings of the learned and the ignorant, as regards the English school having no fixed principles of design. Indeed, in fresco we shall be able to answer every objection. Who knows but, in the midst of our fresco labours, the public may take us up on this ground of design, and see us through our difficult task of establishing historical art. The active capabilities of the Englishman are universally known; and it is enough that he has the warm support of his countrymen to accomplish anything, however great or difficult. Now, in historical painting he has never yet had this advantage, for the English public has been ever cold and discouraging on almost all occasions of English painters having the misfortune to produce historical works. I am obliged to say misfortune, because I understand large historical pictures are never bought, and never looked at but with feelings of pity. This will be at an end in fresco, for the patronage of the State (we have seen it in all ages, and even now in the various continental states which excel in high art,) is the only means by which a school of history-painting can be formed. The admirable way the State now proposes to do it through the medium of fresco, is the first real chance the English painter has had in his own country, whatever his success may have been elsewhere.

I may take notice here of the great encouragement always given by the English government to sculpture, to the total discouragement and disparagement of painting, which is singular, as in other countries painting has predominated in national art, for it has greater means in its closer imitation of nature to represent all national acts of war or peace. It has the power of representing men as they are, with their own proper actions and dresses; it has the power of representing everything about them, the air they breathe, and the element in which they distinguish themselves, be it on the earth, or in the water, or the air, or even in the fire; for Englishmen, in that wild, romantic spirit, which distinguishes them from other people, revel and live in all these elements, and, I should say, require the universal power of painting to record their actions, rather than the limited range of sculpture, which always rejects the actual dress, and has no power over the aforesaid elements. The only thing we have in this way, is the little Naval Gallery at Greenwich Hospital; and it is impossible not to be struck with the admirable use and power of this accidental collection, for I believe not any one of those interesting battle pictures was done for the purpose. The old sailors show you round, and describe the subjects in which they themselves were engaged, and at the time you, yourself, become a sailor, for I confess I never knew so much before of our great naval victories as I learned in my visits to this humble gallery. Now what in sculpture will compare with this? what is there that can so come home to us? Will Nelson, at the top of that expensive column, compare with it? certainly not: and yet that meritorious gallery of naval pictures, did not cost so much as the base alone of that proud column. This Greenwich Gallery I take as a golden augury of the success of the proposed national history painting in fresco; for this Sailor Gallery is quite enough to show what fine things Englishmen will do in national painting, when they are working under the patronage of the State and the people, neither of which had they in the pictures I allude to. I do not mean in these remarks to find fault with English sculpture, or grumble at its success; I would not say that it had been encouraged too much, but rather that painting has not been encouraged enough; that other nations make painting and sculpture go hand in hand in the commemoration of national greatness. In France, painting has predominated, in Germany the same, and in Italy always. Here we have had nothing but sculpture, which is singular, as the English are considered to excel more in painting. It may be that the want of fresco has been the cause.

The revival of our Gothic architecture in the new Houses of Parliament must be looked upon as a singularly fortunate circumstance, as regards the formation of a style of fresco painting which shall be our own, both as to subject and the manner of treating it. I mean that this noble style of architecture, replete with beauty and grandeur as it is, and more applicable to all our uses than any other, *is entirely our own*, as it grew up amongst us in the early times, was carried to perfection by us, and, singularly enough, we have still the finest specimens in the world. It belongs to us as Englishmen, and associates with the grandest periods of our history; and we are fortunate in having a British architect, whose genius has caught up the spirit and power, and revived it, as though he had lived in the "olden time." Now this elevated English style, rising into splendour again in the new Parliament Houses, will be the fortunate occasion (and perhaps no occasion could have been so fortunate) of our calling up a style of historical painting in unison with it, that shall be our own, as is the architecture—that shall be bold, manly, and English in all its characteristics, and have beauty and power like the building. Nor do I see such great difficulties in the English school attaining this excellence, as many suppose; for it must be considered, that the British public and the British artists will go hand in hand, mutually assisting each other, both inspired by the English style of architecture, and nerved to revive all the other English arts so closely connected with our national feelings. We shall have fresco painting, wood carving, and stained glass; and we have a wonderful collection of British illuminated MSS, which will form a fine field wherein to hunt for national art, all of which we take up again from the early times of England, when Westminster Hall was built, than which nothing grander, more majestic, or so well suited to fresco painting, exists from one end of Italy to the other. Our former experiments have mostly been in the classic, either Greek or Roman, but always foreign to us, and we never entered deeply into them. We are not a classic people; our tendency nationally is to the romantic histories and customs of the middle ages. We are essentially English in this, our literature tends to it, and is first-rate withal; our finest architecture the same, and still first-rate: then why, if we are now to form a style of national painting, should it not be the same, and with the same bright hopes? Who can visit that magnificent hall of Westminster without thinking on the illustrious deeds of Englishmen? and who that forms these pictures in his mind forms them classically?—I mean with the semblances of Apollos, Adonises, and the like, after the fashion of our neighbours the French. No, in this place we only think of *Men*—of a hardy race of warriors, legislators, philosophers, all working-day men, who never even dreamed of such things as modern art produces. The tame creations of French academies, or the fashionable ones formed from English theatres, are things to shut our eyes at, that we may open them to behold a race of *men* who sturdily gave England the groundwork of her greatness, before academies or theatricals were thought of. Fashion may possibly lend a grace to many things, but certainly never to historical painting.

The greatest charm of historical painting is, to transport us to the time and place it attempts to represent; our architecture does this, and our painting must do it, or the English people will never be satisfied. In other countries art was made great in this way, for Raffaello, although called classical, is essentially Christian, and associates in his frescos with the period of our architecture. Roman soldiers he puts in the Gothic armour of the Swiss guards, and the same feeling of his time is apparent throughout his works; even his Madonnas are Gothic; yet he took everything he could find to his purpose in the antique, though he never ceased to produce what we may really call Christian art, which was his own feeling. Here is an example for us. But perhaps a better one may be found in our own times in Germany, where, in the revival of the fresco art, the artists have boldly dared to create a style independent of the antique; and, in treating subjects of the middle ages, have produced a style of design, not so classically correct as the Italian, but so adapted to the subjects of those times, so manly and vigorous, with their Gothic heroes so completely called up, that I doubt whether anything more original in art has ever been done. Now it is in this, and not in the mere fresco material, that we should do well to study them. We could borrow some of their magnificent cartoons, which, though done in simple charcoal, are wonderful productions of art, and would astonish us here; for the means are almost nothing, yet the result everything. A studied German cartoon is replete with invention, composition, design, and character, and all this in charcoal alone. It is impossible to imagine the result of such excellent preparations for a picture, or the pleasure to the painter of adding colour and effect—and *such* colour and such effect as an Englishman can add to such preparations. Perhaps I should explain here, that the paper used for this purpose is prepared by a simple wash of very thin glue, which glue, when the charcoal drawing is done, undergoes a steaming from a two or three spouted tea-kettle, with a spirit lamp to keep the water boiling; this easily incorporates the charcoal in the melted glue, and the result is, a solid surface, like a picture. I remember two immense cartoons, which Cornelius executed at Rome in this way, and when done, he cut them into convenient sizes to roll and carry to Germany for the fresco painting. No doubt, the sight of some of these would greatly assist and gratify us; and these we could easily have, for the German artists are as liberal as they are accomplished. As for the fresco material, it is so easy, so simple, and so sure, that I cannot but think we should learn it better by ourselves, rather than pick up the vices of others; for although it may be feared that the first specimens of fresco may appear crude and inharmonious to the English eye, accustomed to the bland, glazing method of oil painting, yet it must be considered, that we are an acknowledged school of colourists, and in so high a degree that it might be cited as the only genuine remnant of fine art in the world in these deploring times; and this alone ought to give singular advantages to English fresco painting. Here may also be considered the height to which the English purification of colours is carried, in their chemical nature as well as their principles in art. This alone, I anticipate, will revive some of the splendours of Italian fresco colouring, in which the Germans have not yet succeeded, and no doubt for this reason. These advantages, joined to well-studied English cartoons, and subjects from our noble history, seem to me a Paradise of Art—a thing to enchant the whole race of English artists, whether in regard to animals, figures, landscapes, flowers, sea-pieces, or even ornamental painting. The facility with which they will exercise their new art, compared with the labour of oil painting, I am sure must win them to think more kindly of fresco when they understand it.

In one point I am confident that they will be brilliantly successful, I mean in the varied effects of aërial perspective; for as this is a part so laborious and difficult in oil, and in which the continental artists never succeed, except when they paint fresco; so I am certain the English artists in this point will surpass themselves, for in the process of the fresco drying, in the change from the wet plaster to the dry, so many beautiful effects come out, that I look forward to the English carrying it further than they have carried water-colour painting, which is acknowledged to be most perfect, and is entirely of English origin.

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enable them to unite, and
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for as the architecture is made up of uniformity, so must there be in the painting something which exists in common. It is for this reason we find such simplicity in the composition of Raffaello's "School of Athens," and, indeed, in all his frescos. This may also account for the simplicity of early painting generally, which was invariably adapted to the purposes of architecture. The artist, indeed, in forming a composition in fresco for architecture, must be guided by all the architectural forms around him; he is reduced to and forced into the simple style of art, if he wishes to be effective. The finest altar-pieces have all something architectural in their composition which is necessary to harmonize with the columns and the arch which surround the picture. I mention this particularly, as I fear it is a style little known and less practised by painters in this country; yet, I dare say, well enough understood by architects, who, no doubt, remember the nature of the composition in the Italian fresco pictures to which I now allude. This style may be the most difficult part of fresco for us to acquire, for certainly it is that wherein Englishmen are inferior to foreigners. In our compositions generally, judging from our Exhibitions, there is little of breadth or simplicity, except in water-colour drawings, which, singular enough, as I found to resemble fresco in colour and effect, so I think they have some of its simplicity of composition, both in landscapes and figures. In oil, on the contrary, composition is lost in a multitude of parts—in fact, Art is studied rather than Nature.

The Theatre has a greater influence on painting than we are aware of which influence must be baneful in every way, for nothing can be more opposed to the purposes we are speaking of than a theatrical taste. In this sense, it is unfortunate to have a theatre so perfect as ours, for the influence extends to both the artists and the public. This taste, carried into fresco would be hideous, but I am sure architecture alone will correct it. A strong proof of the theatrical taste existing here in painting, is, that the English prefer Retzch's designs from Faust, to those of Cornelius, or, indeed, any other German works. Now, the slightest glance of an eye practised in historical works, would find that Retzch's designs are entirely made up in the theatrical taste, and it is on this account they have been preferred by the English, and published here in numerous editions, whilst in Germany they are thought worthless. The grand designs of Cornelius, from the Faust, are not known here at all. So here is a difficulty we really have to get over. There will be much to unlearn on the part of the public, and much to forego on the part of the artists.

In the introduction of historical painting in fresco, the difficulty I hear everybody speaking of, is "How are the artists to learn?" Now it seems, in my opinion, the difficulty is, *how are they to* UNLEARN; for the going forward in historical fresco must be by going back—and back to the fine old and powerful styles, as we have done in architecture, and in getting sure possession, once more, of the strongholds of Art, which we have lost in the search after novelty. In the desire to be new, we have merely taken what other men have left. We must return back to the fine solid Art, as Reynolds did, and add to his labours correct and manly design. Nothing complete or individual (I hate the abused word original) can be attained, if the artist be not well and thoroughly acquainted with all that has been done in his art; if he has not seen with his own eyes—aye, and open, too—the whole range of that art which he professes, as Reynolds did; otherwise he blindly and ignorantly stumbles on some common-place, which has been done better by a hundred others, and which he might have avoided had he allowed himself to know it. I say allowed himself, for the prejudices of painters are proverbial, and are easy to be seen in an Exhibition, where so many aim at a chimney-corner kind of art, if I may so express it; for it is local and limited, and made up of servile imitation, without imagination; and painting without imagination is not Art. Of course I allude solely to historical painting. This can never do in fresco painting, but will, in the artist's new life, hang like a millstone about his neck.

Raffaello, when he began his frescos in the Vatican, looked about him, and embraced and made his own everything that could help him; we see in his works figures and groups from the Roman antiquities, from Giotto and Massaccio, and he even sent young men to Athens to draw the marbles of Phidias, for his object was, to advance the art, rather than himself.

These remarks apply to the introduction of fresco-painting in this country; for it is so different in all its objects, in all its means, that few can imagine it existing on that slender thread of life which painting now finds here. What are the combined powers of a modern exhibition to the purpose? what, but each artist trying the powers of others, instead of his own; diverging annually from his own proper feeling in that rage for novelty and fashion which characterizes the age? and what is the result of these annual thousands of exhibition works, *but a positive dram-drinking at the eye?* Such must never be the groundwork of fresco, or its failure is certain; and such, I am sure, it will not be, for every artist will be gratified to have his work remain in the place he painted it for, with the same light and the same object,—things he can never have, or even think of, in an exhibition.

The immoveability of fresco may, I think, be considered as an advantage. In Italy, certainly, where it exists as part of the building, it defied the French rapacity, for, by Napoleon's orders, every oil picture was removed to satisfy Parisian vanity. It was in vain that many Italian cities endeavoured to ransom the immortal works of their countrymen: the French took the ransom, and then the pictures. But the frescos remain to uphold Italian greatness; they could not be removed without utter destruction, so that the greatest works of M. Angelo, of Raffaello, of Domenichino, Guercino, of Guido, and the Caracci, stood, and still stand untouched, whilst the oil pictures which went to Paris were mostly injured by the French artists pretending to restore them. The "Transfiguration" of Raffaello alone will prove this fact: it has that glaring French colour, chrome, on many of the lights; and, indeed, when the present state of the picture is compared with old copies, particularly the mosaic in St. Peter's, it seems to have lost, in French hands, all harmony of colour, all union of light and shade. Now a fresco has no fear of picture cleaning, for the dirt may be easily removed with simple water. Very lately, the Vatican frescos were admirably cleaned with crumb of bread.

As regards the durability of fresco in this climate, I should certainly be in its favour; for I have observed that fresco is more destroyed by a dampness arising from the foundation of the building, and in the soil, than from any effect of the atmosphere. Indeed, I cannot think the serious decay of the frescos of M. Angelo, Raffaello, and others, at Rome, is satisfactorily accounted for at present. We are told the smoke of the candles, in the Sistine Chapel, has destroyed the "Last Judgment," and that the sack of Rome by the Constable Bourbon, was the cause of the early destruction of Raffaello's frescos in the Vatican, because the German troops made fires in the rooms. Now these assertions fall to the ground, when it is considered that recently the Pauline Chapel (in which was performed the ceremony of watching the Host with some thousands of candles,) was cleaned, and M. Angelo's frescos (before invisible from soot) came out quite as well as those in the Sistine Chapel, where the candles are comparatively but few. This is a proof that the smoke is not the cause of the decay. As regards Raffaello's frescos, I have a proof that fire itself does not destroy the fresco material; so that, in this dilemma, I venture to trace the cause of this singular dilapidation of the finest Roman frescos *to the dampness of the soil of Rome*, which is beyond what I have observed in other places. As I passed sixteen summers there, I can judge of its pernicious effects, and have no doubt that it attacks the foundations of the buildings, and must in this way cause the decay. The Vatican is unhealthy on this account in the summer, and one cannot sleep there with impunity. This dampness is found not only in the plains, but the hills of Rome, though not equally; and even at St. Gregorio, on the Celian Hill, the more recent frescos of Guido and Domenichino are decaying. In explaining and accounting for this painful fact, I beg to remark, further, in confirmation of my opinion, that the decay seems more particularly striking in the inner walls, where there is little or no ventilation, whilst the outer walls are comparatively well preserved, as are also the ceilings. This decay in fresco pictures seems confined to Rome, for at Sienna they are admirably preserved. The same at Florence, where, even in the open air, Andrea del Sarto's frescos are in good preservation. Sienna and Florence are dry in their soils, and hence the fact. The modern frescos at Munich also stand well, although the climate is worse than ours; but the soil is gravel, and so they are likely to be well preserved, even in the open air. The soil of London is well adapted to fresco, both as to its nature, as well as the excellent drainage, for our buildings have the singular advantage of dry foundations. *We have habitable rooms under ground always dry*, a thing not to be found in any part of Italy, where even the ground floor, which answers to our parlours, is scarcely habitable. The floors under ground are always cellars, and have to be entered with great caution, on account of the damp. No doubt the ancient Romans must have had a system of drainage similar to ours, to have made their city so different from the present, as regards health. I believe most of the old specimens of our early frescos are in good preservation, considering the way they have been treated—first with disdain, and then with whitewash.

As applicable to England, I would also say, that the durability of fresco against fire is not one of its least advantages. This was proved at Florence, where, after the church of the Carmine was burnt down, and they commenced clearing away the ruins, Massaccio's frescos were found to be entire, and they exist on the same walls to this day; whereas, at Venice, the greatest works of Titian—his battles of the Republic, painted in oil colours—were all destroyed in the burning of the Senate House.

I have now enumerated many of the advantages which will result from the introduction of fresco painting into England. I have considered, and, I trust, to some extent proved, its claim, as the only style of painting adapted to our architecture, from its light being suited to all times and places—its powers in colour and effect being equal to the powers of water colour and oil painting combined together—its durability, suited to the nature of our soil and climate, and even our customs, including the accidents of fire; and in conclusion I will observe, that the cheapness with which it may be executed—certainly, I should say, one-half the price of oil painting—will confirm and ensure all these singular advantages. I have no doubt, therefore, we shall have English painting extend from one end of the kingdom to the other, as a universal language. In looking on the greatness of fresco, and its positive relation to architecture, I would say that fresco painting is the true sister of architecture, and oil painting only the sister-in-law.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.*

SECOND COURSE—LECTURE I.—RAILWAYS.

Mr. Vignoles commenced by saying, that, in pursuance of the order stated in his introductory lecture, he would proceed to investigate the principles upon which railways should be laid out under varying circumstances. In calculating the power (of whatever description it may be) necessary to overcome the resistance of a load to be moved on any railway or road, it may be divided into two parts—viz. that necessary to overcome gravity, and that required to meet friction. The former is, of course, common to, and equal on, all descriptions of roads deviating from the horizontal line, and is in proportion to the sine of the angle of inclination; the latter is regulated by the degree of perfection of the road, and of the vehicles moved upon it, and includes the resistance of all obstacles to the rolling surface, or periphery of the wheel, in addition to the axle friction due to the load or weight placed upon the carriage. It has been assumed, from experiments and observation, that the average friction upon a railway is 9 lb. per ton, and that this continues the same at all velocities; but there is reason to believe that the latter part of the assumption must be much qualified. The gravity due to the inclination of the plane being added to, or subtracted from, the friction, as the plane rises or falls, the sum, or difference, will give the total amount of power necessary to overcome the resistance of the load. The power necessary to overcome the gravity being expressed by the proportion which the rise of the plane bears to the weight to be raised (say, for example, a ton), is found by dividing 2240, the number of pounds in a ton, by the denominator of the fraction which expresses the inclination of the plane; thus, on a plane rising one foot vertically in a horizontal distance of 1000 feet, the fractional expression is $\frac{1}{1000}$, and the power (retarding or aiding the load), will be the thousandth part of a ton, or $2\frac{1}{4}$ lb. It is evident that, as we arrive at steeper inclinations, this power will at length become equal to that required to overcome the friction; thus, on an inclination of $\frac{1}{250}$, it will be $\frac{2240}{250}=9$ lb. per ton, and this being subtracted from the friction, on a railway which is commonly taken at that same amount of 9 lb. per ton, it results that no power is required to move a load down such an inclination, or wherever the gravity and friction are equal, and balance each other. The angle that such an inclination makes is called the angle of repose, but will, of course, vary with the friction due to various descriptions of roads and vehicles. On steeper inclines than such, not only is no power wanted, but there is a gravitating power due to the descent of the plane, and so strongly does this act in steep inclinations, that it is necessary to put on the break, to retard the velocity which it occasions. It is found, however, when a train is allowed to descend a steep plane without retardation, that, owing to the resistance of the air, it will, after acquiring a certain velocity, cease to be further accelerated; many theoretical writers have fallen into error, by supposing it dangerous to allow trains to descend inclinations steeper than the angle of repose without applying the break. On railways where there are inclined planes of $\frac{1}{100}$, for several miles together, the trains often commence the descent at the rate of upwards of forty miles an hour, and the speed, instead of being accelerated, has been quickly reduced to little more than the thirty miles an hour, or to such uniform velocity that a railway train will acquire on that inclination, varying a little with the weight of carriages, or the length of the train; such being the case, it is evident that lines of railway for locomotive power, can be safely laid out with inclinations of 1 in 100, and even steeper.

It is of the utmost importance, in laying out a line, to consider the power which is proposed to be employed, and the mode of obtaining it; thus, if it be intended to lay out a horse railway, to carry coal from a colliery to a shipping place, the line should be made always to descend, and so regulated, that the number of full wagons that may be sent down be that number which may be taken back empty. But horse-power being extremely limited, recourse is had to steam, and the locomotive steam-engine has been applied to railway travelling, as being better suited to the purpose than animal power. The power of the locomotive engine may be defined, not so much by horse power, or cylinder power, as by boiler power, or capability of rapidly supplying steam to the cylinders, and still more by adhesive power, or the weight insistent on the driving wheels, so as to have purchase, as it were, to drag the load after it, for the wheels will slide, more or less, and, under some circumstances, will merely turn round on the rails, without progressing. Many lines appear to have been laid out under the impression that the locomotive engines would always have to carry a *maximum* load, and, in accordance with this principle, and to enable them to do so, it was some short time since laid down as an axiom, that no inclinations should exceed $\frac{1}{330}$, and that gradients should be constantly uniform through the whole length of a line. Experience has shown, however, that the practical cost of conveyance of ordinary trains over lines greatly varying in their gradients, does not materially differ, the wear, and tear, and fuel, seldom being increased so much as 10 per cent., and the other expences and contingences being the same, whatever the gradient of the railway, the difference on the whole expence of working and maintenance becomes very small indeed. In laying out a line, then, the traffic most be considered quite as much in the distribution of it as in the totality; for it is evident that, to accommodate the public, the trains ought to go often, and will, therefore, generally be light; and when we consider the great economy in construction, and the little additional expense incurred in the after working, we may conclude that railways may be advantageously laid out with much steeper inclinations than they have in general hitherto been, particularly in the remoter districts, where the railway system has not yet been extended. A powerful engine will draw an immense load on a level, whereas it often has not more than twenty tons to draw—consequently, gravity ceases to become an object; and even should the traffic increase in course of time, it will be better to send frequent and light trains than, in the original construction, to incur heavy cost to graduate the road for heavy trains, which are seldom to be carried. This principle must, of course, be confined within certain limits; thus, lines may be laid out with better gradients, where the traffic is very great, and will justify the expense and inconvenience which might result from an engine having always to go up a steep ascent. Railways in England have cost, on the average, £30,000 per mile, and the first cost of locomotive power does not amount to one-fifteenth of that sum. The interest on the capital is, therefore, very great, while that on the power is small, as is also, comparatively speaking, the daily cost of transit due to the power only. If these proportions were different, the latter being increased, while the larger amount (the interest on the cost of the works) were diminished, the capital sunk in railways might have been reduced fully one-half, with equal satisfaction and benefit to the public, for whose use they were designed, and with greater profit to the shareholders.

LECTURE II. RAILWAYS—LOCOMOTIVE POWER.

In the last lecture it had been stated that the adhesive power of the locomotive engine depended upon the weight borne upon the driving-wheels. The greatest amount of adhesion of iron upon iron, according to the experiments of the eminent engineer, Mr. George Rennie, as published in the *Philosophical Transactions*, appears to be about one-sixth or one-seventh of the weight of the insistent load. In the locomotive engine, where the bearing of the wheels is upon smooth surfaces, the adhesion will, of course, be less; and in weather when rime or mist congeals upon the rails, it is very small indeed, sometimes none at all. But in ordinary states of the rails, and of the atmosphere, one-fifteenth may be taken as an average. The vicissitudes to which this power is subject, will often account for the varying rates of railway travelling, and it is only when the resistance of the load is less than the smallest amount of adhesive power which the state of the weather or the rails will admit, that the time of transit of a train over any given distance can be insured. Now, the usual weight bearing upon the driving-wheels of an ordinary locomotive, for passenger traffic, is about seven tons, or 15,680 lb.; one-fifteenth of this will be 1042 lb., or, in round numbers, say 1000 lb., for the average available adhesive power of such an engine for moving a load, and on the amount of this alone will depend the weight which the locomotive engine can draw after it. The other principal element which must be taken into account in the locomotive engine—viz. the speed—will depend mainly upon the power of the boiler to generate steam with sufficient rapidity. A boiler may have quite sufficient power to move (at a velocity of three miles an hour) a load of which 1000 lb. shall be the representative, but it must be of a far superior description, and far higher powers, to move the same load at a velocity of thirty miles an hour; and this subject does not appear to have been sufficiently considered, though it is of such paramount importance thoroughly to understand the nature of the moving power to be used, before going into the subject of the gradients, or the principles of laying out the line. The amount of the load, then, which the engine can draw, will depend chiefly on the adhesion, and the velocity will depend on the boiler where the stream is generated, the cylinders being proportioned to each of these two other regulating powers. And not only must the steam be generated to a given pressure to produce that power, but with sufficient rapidity to continue it; and in keeping up a high velocity, it must be, as it were, rammed into the cylinders, so as to produce the greatest possible effect in the least possible time, and this is the reason why high velocities are so very expensive, as the same effect might be produced by one-fourth the quantity of steam, if sufficient time were given to expand it. But there is yet another circumstance that modifies the amount of adhesion—viz. the inclination of the road. It is manifest that, if the road were vertical, the engine could have no adhesion upon the rails; and, therefore, between the perpendicular and horizontal lines, the power must undergo many degrees of variation, quite independent of the atmospheric causes already mentioned. We have no experiments to determine the ratio of that variation, but, reasoning from analogy, it may be assumed to be as the sine of the angle of inclination, or in the same proportion as the resistance arising from gravity, so that practically the diminished amount of adhesion, on any inclined plane, might be found by deducting the resistance of gravity on that plane from the constant of 1000 given above; thus, on an inclination of 1 in 100, the gravity of the engine per ton (or 2240 lb.) will be $\frac{2240}{100}=22{\cdot}4$ lb., and that for seven tons will be $22{\cdot}4\times7=157$ lb., which, subtracted from 1000, will give 843 lb. = the diminished amount of adhesion, which will be the limit of the power of the engine on that incline, as regards the load, no matter how great the boiler or cylinder power may be. And to find the load which this power will draw, we must take the sum of the resistances arising from gravity and friction for one ton, and the adhesive power divided by this sum will be the amount sought in tons; on an inclined plane of 1 in 100, the calculation will be found thus:—Friction 9 lb. per ton, *plus* gravity as before, $22{\cdot}4=31{\cdot}4$ lb., and adhesive power 843, divided by $31{\cdot}4=26{\cdot}7$ tons, which is only one-fourth of what might be drawn on a horizontal line. Hence the advantage of heavier engines, which are daily coming into use, as also the propriety of coupling the wheels of engines for drawing heavier loads up steep inclines, and by this means the whole insistent weight of the engine is rendered effective by adhesion, and the load the engine can draw after it proportionally increased. In calculating the amount of resistance of a load upon a railway, the friction had been assumed to be 9 lb. per ton, rather in deference to general opinion than otherwise; it was probably much higher. It is considered that the friction of the engine and engine gear is 16 lb. to the ton, but that of the lighter carriages less; however, if this number (9 lb.) should be proved incorrect by future experiments, the principle of the calculation will not be altered, and it will only be necessary to substitute the true number instead of 9. The same may be said with regard to the adhesion; it will only be necessary to substitute for 1000 whatever number shall be found on closer investigation to be nearer the truth.

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* We are indebted for these reports to our cotemporary the "Mining Journal."

The power generated in the boiler, and applied in the cylinders, now remains to be brought under consideration. This may be stated to be the capability of the boiler to supply steam of high pressure, to enable the piston to perform a given number of strokes per minute, which accordingly will be one of the essential elements in computing the power of the engine; and therefore it is that we are always unwilling to define it by any number of horses' power, since it is clear that the engine which, moving at the rate of 15 miles an hour, would be called a 20-horse engine, would be styled a 40-horse engine when moving at the rate of 30 miles an hour, all other circumstances remaining the same. But it does not follow that, because the number of strokes per minute be increased, that the power available for locomotion be increased also, and in this consists the essential difference between locomotive and stationary engines, for in the former there are circumstances, as before shown, which circumscribe that power, over which the boiler has no control; and, as regards the locomotive engine, a third point must be taken into consideration. It is a well-known theory, that, if a metallic substance be in contact on one side with water, and that heat be applied to the other, that once the body becomes thoroughly warmed, the caloric will be taken up by the water with as much rapidity as it can be supplied to the metal. Now, in the locomotive engine, there is an immense area of heating surface in contact with the water in the boiler, in consequence of the numerous tubes which pass through it from the fire-box to the chimney, and it is on this principle that what is called the steam draft has been introduced, by which means the caloric is rapidly drawn from the fire through these tubes, and as rapidly absorbed by the water with which they are in contact, for the production of steam. It is evident that, in proportion to the rapidity with which the piston moves, and with which the waste steam is injected into the chimney, will the heat be absorbed by the water from the tubes and steam generated, the effect of which is, that the faster the engine goes, the quicker it generates the steam; and this forms another great beauty and peculiarity in the locomotive engine. The principles of calculating the moving power being thus explained, the way has been sufficiently cleared for entering on the subject of the laying out of railways.

LECTURE III.—After recapitulating a few of the leading points which were stated in the last lecture, the Professor called particular attention to the formula whereon he had based the calculations into which he had then entered, and he now exhibited tables and diagrams in further illustration. The adhesive power of 1000 lbs. was assumed as the average of what a locomotive engine will have in all states of the weather, and of the rails; but if the wheels be coupled, or the insistent weight otherwise increased or diminished, the adhesive power (on which depends the load) will be altered in the same proportion, subject also to variation from the state of the weather and the road, and undergoing the stated diminutions from the effects of gravity on all planes which depart from a horizontal line, the velocity of the train depending on the evaporating power of the boiler. But in the stationary system the engine winds (upon a roller, or over a sheave or wheel) a rope supported by pullies, placed at regular distances along the road, and to which rope the train is attached. Mr. Vignoles stated that the student may refer with confidence for every information on this subject, to Mr. Wood's *Treatise on Railways*, and commented on the extracts he made from that work.

Atmospheric Railway.—There is also another mode of applying the stationary engine to the purposes of locomotion, by producing through an air pump a partial vacuum in a pipe, thus making atmospheric pressure the moving power; and it may be interesting to state, that the scientific men who were appointed by the railway department of the Board of Trade to inquire into the system of the Atmospheric Railway, had fully recognised that principle, and concurred in considering that the experiment contemplated upon the Dublin and Kingstown Railway extension, and recommended by the directors to the proprietors, as applicable for illustrating the principle on a large scale. On the atmospheric railway the diameter of the pipe or tube regulates the load, but the velocity depends almost entirely upon the diameter of the air pump that exhausts the pipe, the rule being that the area of the air pump must be made as many times greater than the area of the pipe, as the velocity of the train is to exceed that of the piston of the air pump. Thus, if the piston of the air pump be supposed to move at a rate of three miles an hour, and it be required to move a train at a velocity of thirty miles an hour, the area of the air pump must be made ten times the area of the pipe; the diameter will, of course, be deduced from that area. Now, it appears that the most economical pressure in the pipe (which is what engineers must chiefly look to,) is about 7 lb. to the square inch, or rather less than half a vacuum; therefore, this may be taken as the constant of the atmospheric pressure; and if we multiply this constant by the area of the travelling piston in inches, we shall obtain the effective pressure upon that piston, which, as it regulates the load, may be said to correspond to the adhesive power in the locomotive engine, but which, unlike that power in the locomotive, will be undiminished on inclined planes. Again, if we divide this power by the friction (which was before taken at 9 lb. to the ton), we shall obtain the number of tons which the piston, acted on by the atmospheric pressure. is capable of propelling. Thus, supposing we have a pipe of 14 inches diameter, if we multiply the area of this pipe by 7 lb., we shall find the effective pressure equal to 1078 lb., which, divided by the friction, 9lb., will give about 120 tons—the weight which can be propelled by means of a pipe of that diameter; and if the piston of the air pump move at the rate of three miles an hour, and its area equal to seven times that of the pipe, the load will be moved with a velocity of twenty-one miles an hour, and it may be demonstrated that, on ascending and descending planes, the speed, although increased or diminished at first, will soon become uniform. Of course, upon the diameter of the air pump will depend the power of the engine which is to work it. The calculations in this case will be similar to those for an engine required to work ropes—in the one case it being required to find what is wanted to overcome the resistance and friction from ropes, pullies, &c., and in the latter to find the power to work the air pump, and exhaust the air from the tube at any required velocity.

Inclined Planes.—The Professor then recurred to the effect of trains descending inclined planes. Mr. Navier (in his work, translated by Mr. M'Neill, which he mentioned as a text book on the comparison of different lines of railway) differed somewhat from the propositions he had laid down; it was therein stated, and Professor Barlow concurred in the statement, that an engine and train did not gain any advantage in descending planes steeper than a certain inclination which they have put as the angle of répose. Now, in practice, Mr. Vignoles did not find it so, but, on the contrary, daily experience proved that, as far as inclinations of sixty feet in a mile, the trains may, under almost all circumstances, have the full benefit of gravity in the descent. Professor Barlow has laid down, in several important works, which from their high standing, will have a material influence upon the public mind, that though additional power be required to surmount steep inclinations, yet, so far from gaining a corresponding advantage in the descent, there will result rather an injurious effect from the necessity of applying the break. Now, it has been already mentioned, and experiments have been repeatedly made by Mr. Wood, Dr. Lardner, and others, showing that, when engines descend long inclined planes, such as those on the Croydon Railway, the application of the break is seldom necessary, the speed that would be due to the accelerating force of gravity, being reduced by the resistance of the atmosphere, until it settles down to a uniform and safe velocity. It is evident, therefore, that there is a great deal yet to learn on this subject, when we find authority and practice differing so materially. Mr. Vignoles observed, in conclusion, that, as the laying out of the lines of railway ought to be strictly regulated by the power to be used for locomotion, as well as of the load of each train, and the nature of the traffic, it becomes interesting to consider these principles in respect of the extension of the railway system in this and in other countries; for, looking at the enormous outlay hitherto incurred, lines through remote districts would not be undertaken, unless the first cost of railways, and the annual expense of working and maintaining them, were reduced to a *minimum*.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

Feb. 1.—The PRESIDENT in the Chair.

"*A memoir of Captain Huddart.*" By William Cotton, F.R.S., &c.

This memoir is intended by the author chiefly to supply some additional facts which are omitted in the account which was published by his son soon after the decease of this distinguished man, whose "great powers of mind, indefatigable industry, and high principles, raised him to a most honourable position in the rank of men of science." Joseph Huddart was born at Allonby, in Cumberland, the 11th January, 1740. His father was a shoemaker and farmer, and had also a small interest in a herring fishery. Young Huddart was placed under the tuition of Mr. Wilson, the clergyman of the village, and from his son, who had been at Glasgow, he acquired some knowledge of mathematics and astronomy. He early displayed much ingenuity in the construction of models of vessels and of machinery; and while herding his father's cattle, he was occupied in mathematical reading, drawing, and calculations. His determination to adopt a seafaring life was opposed by his friends; and it was not until he was called upon to take his share of the duties on board the herring-fishing boats, that his father was reconciled to his becoming a sailor. At this period, during the hours of rest after his labours, he was engaged in making nautical observations, and laid the foundation for the chart of St. George's Channel, which was laid down by him, and published by his friend, Mr. Laurie, and still is the best chart of that locality. On the death of his father, in 1762, he took the command of a sloop which was employed in carrying salt herrings to Ireland. He then constructed a brig according to a model of his own, every timber being moulded by his own hands. In this vessel he traded for some years to America; until, in 1771, he was induced by Sir Richard Hotham (who had discovered and appreciated his judgment and knowledge) to leave the brig and engage in the East India mercantile marine. "In this extensive field of usefulness, Huddart evinced the superiority of his talents and his inflexible integrity;" and his example as a commander was generally followed. While in the Indian service his attention was drawn to the defects in the usual manufacture of cordage, and led to the improvements which he afterwards so successfully accomplished. He subsequently took a prominent part in the direction of affairs at the Trinity House, the Ramsgate Harbour Trust, and the London and East India Docks, where the valuable advice given by him was properly appreciated, as it was also by the civil engineer, with whom he was called upon so frequently to co-operate. The memoir then relates many interesting anecdotes of his private life, illustrative of his general scientific acquirements, and of his amiable disposition. It then details, at considerable length, his experiments for the determination of the lines for ships, which, consistent with stability, and what might be required for stowage of cargo, would give the greatest velocity through the water. The author enters fully into the account of Huddart's inventions and improvements in rope machinery, which he raised to such a pitch of perfection. This machinery, which is now transferred to the Royal Dock Yards, has already been before brought under the notice of the Institution by Mr. Cotton and by Messrs. Dempsey and Birch, in communications for which prizes were awarded. The general introduction of chain cables rendered this machinery less useful, but could not take from its original merit; and, in its present position, it will long remain a monument of Captain Huddart's perseverance, mechanical skill, and scientific knowledge.

Remarks.—Sir James South thought that Captain Huddart's scientific attainments as an astronomer had not received their due meed of praise in the memoir; but more especially, that the equatorial instrument, which he was now fortunate enough to have in his possession, should have been alluded to more particularly. That instrument was constructed by Messrs. Luke Howard & Co., of Old-street, from the designs and under the daily superintendence of Huddart. The greatest part of the instrument was put together with his own hands, and the result of this combination of skill and attention was, that, up to the present time, the instrument had been unequalled; in fact, he must be permitted to say, that he considered it *perfect*. It had been used for all kinds of observations—transit, declination, and equatorial; and, in all, with equal satisfaction to the astronomer. With it Mr. Herschel had made many of his observations, and always expressed himself in the highest terms of it. It had been examined by most of the eminent constructors of instruments, as well as many civil engineers, who all entertained the same opinion of its perfection; and, after a minute inspection, one constructor observed, "Here is the best system of edge-bars and bracing I ever saw, and my opinion of the instrument is, that it is perfect in every part." Sir James then related several anecdotes of Huddart's habits of observation. On one occasion, being ordered to sail from Madras at a certain time, he delayed his departure, because he observed a sudden fall of nearly three-quarters of an inch in the mercury of the barometer. The result of this disobedience of orders (for which he incurred momentary censure,) was, that his vessel alone of all the convoy escaped destruction.

The President believed that Captain Huddart was the first to mark out the direct course to China, which was so generally followed at present. He was also the first observer who took a transit instrument out there with him, to determine the rate of the chronometer. It was particularly worthy of notice, that the equatorial instrument and the rope machinery, both which had been designed by and executed under the directions of a self-educated man, destitute of the means of acquiring instruction either in astronomy or mechanics, had both been, up to the present time, unequalled either in conception or in the perfection of their execution. Huddart was the constant coadjutor of civil engineers; he assisted the late Mr. Rennie in many of his surveys of harbours, and on those occasions had always the command of the vessel, even if he participated in the actual operations of the survey. Whether Huddart was viewed as a sailor, boldly striking out for himself a new track to his destination; as a ship-builder constructing a vessel in order to avoid the defects which he observed in the ordinary class of ships; as a hydrographer, displaying in his chart of the St. George's Channel those powers of observation and of reasoning which made him an astronomer; as a constructor of the equatorial instrument, which had been so justly commended; or as a mechanic, designing and constructing one of the most beautiful pieces of machinery on record—he appeared equally great. The Institution was much indebted to Mr. Cotton for this Memoir of Captain Huddart, whose name would be always venerated by every member of the profession of civil engineering.

Mr. Thornthwaite must in justice correct a misapprehension relative to the laying machine for the cable; the idea of that machine originated with the Rev. Edmund Cartwright, who had projected more improvements in cotton machinery than any person, except Arkwright. The machine was materially modified by Captain Huddart, and to him must be given all the credit for the perfection of its proportions, and its careful construction, which had enabled a machine weighing 20 tons, and revolving rapidly upon one vertical spindle, to work for a number of years without costing 5*l.* for repairs. The register, which preceded the laying machine several years, was entirely Huddart's invention, and was the origin of his improvements in rope machines.

Feb. 8.—The PRESIDENT in the Chair.

"*Description of the Port of London, and of the Works at the London Docks.*" By Robert Richardson, Grad. Inst. C.E.

In this communication the author examines the state of the Port of London, when the accommodation for landing and bonding foreign produce, was almost entirely limited to a single spot, called the "Legal Quay," which was only about 1,400 feet in length, extending downwards from London Bridge, affording no greater facilities for commerce in the beginning of the nineteenth century than in the year 1660, when this quay was appointed. This state of things continued until the year 1773, when Mr. J. Sharp suggested the formation of floating docks. In the year 1800, the West India Docks were commenced; in the year following the London Docks were projected, and in the year 1805 the East India docks were commenced. For all these undertakings, Mr. Ralph Walker was appointed engineer, having Mr. William Jessop associated with him for the West India Docks. The paper enters fully into the bad state of the navigation of the river, owing to defective management and other causes; gives a table showing the progressive increase of tonnage and number of ships from the beginning to the close of the last century; mentions the various plans of Dodd, Spence, Reveley, and others, for diverting the channel of the river for the formation of more extensive docks, near the Isle of Dogs; and then proceeds to detail minutely the origin and progress of the London Docks, giving the dimensions and mode of construction of the principal works connecting the Eastern Docks with the Thames, which were constructed under the superintendence of Mr. H. R. Palmer, to whom the author has been indebted for much of the information contained in the paper.

The communication is accompanied by fifteen drawings, showing the details of construction of the locks and gates, bridges, quays, embankments, &c.

"*Description of the Ponte della Maddelina, over the River Serchio, near Lucca.*" By Richard Townshend, Assoc. Inst. C. E.

The bridge described in this communication, is situated about half-way between the town and the baths of Lucca, in the Grand Duchy of Tuscany; it was built by Castracani, in the year 1317, on the site of one which had been constructed by order of the Countess Matilda, early in the twelfth century, and subsequently destroyed; it is believed that a Roman bridge formerly existed on the same spot. The present bridge is of grey limestone of the country. The large arch of 126 ft. 6 in. span, is of a semicircular form, and springs directly from the rocky bed of the river, without any prepared foundation. The smaller arches are of various spans, 46 ft. 10 in., 33 ft., 28 ft., and 7 ft. 6 in. The style of construction is somewhat similar to that of the Pont-y-prydd, over the Taff, in South Wales. An engraving of the bridge accompanied the paper.

"*Description of the Mill, Forge, and Furnaces of a Welsh Iron Work.*" By Thomas Girdwood Hardie, Assoc. Inst. C. E.

The author commences by describing the general plan of an iron work, consisting of six blast furnaces, four double-fire refineries, and a forge and mill, capable of converting into bar iron the produce of the six blast furnaces. He then enters very fully into certain alterations of the interior shape of the blast furnaces introduced by him at the Blaenavon works, from which have resulted an economy of fuel, regularity of work, and an improved quality of iron. The principal alterations appear to be, making the interior diameter greater above that at the boches, and establishing a proper ratio between the diameter of the boches and that of the charging place, and proportioning both to the height of the furnace. The opinions are supported by calculations of the quantity of blast used in smelting given quantities of ore, and the effect which the form of the furnaces must have in directing the current of the blast through the materials, by which also the point of fusion would be necessarily affected, and the chemical combinations varied. The particulars are then given of the construction of the furnaces at Blaenavon, and the details of the blowing engines, blast mains, regulators, valves, &c., with calculations of the quantity of blast used in the various processes of the manufacture. The construction of the casting houses, with the mode of ventilating by the iron roof, is detailed. The general arrangements of the balance pits, coke yards, mine kilns, and bridge houses, are shown, and the author proceeds to describe the forge and mill, which have 35 puddling furnaces, with hammers, shears, rolls, and heating furnaces in proportion. He then condemns the usual practice of leaving the coupling boxes loose upon the spindles, as liable to break the rolls, shafts, or machinery, and gives the theoretical and practical reasonings for preferring fixed couplings. The communication is illustrated by three drawings, showing all the details of construction of the iron works.

Remarks.—Mr. Lowe believed that there was an incorrectness in the statement of the iron, after being freed from its oxygen by the heat of the furnace, taking up a dose of carbon from the coke, thus becoming a carburet of iron, which is a fusible compound, and as such fell melted into the hearth. On the contrary, he thought that the iron was combined with carbon in the ore, and that there was not any necessity for the medium of the fuel to charge it with carbon.

Dr. Faraday, in reply to "Why the ore required, or why the iron carried away, any of the carbon of the fuel?" stated, that the ore being essentially a carbonate of iron, the first action of heat, either in the mine kilns or in the furnace, was to draw off the carbonic acid and leave an oxide of iron, and then the further action of the fuel (besides sustaining a high temperature,) was to abstract the oxygen of the oxide, and so to reduce the iron to the metallic state, after which a still farther portion of the carbon of the fuel combined with the iron, bringing it into the state of easily fusible or pig-iron. As carbon may be communicated to the iron in two ways, distinct in their nature, either by contact with solid carbon, as in the process of cementation (that by which steel is commonly converted), or from the carbonated gases, either carburetted hydrogen, or carbonic acid, which occupy nearly every part of the air-way of the furnace, it would be desirable to distinguish, as far as may be in any furnace having a particular form or action, what proportion of the whole effect is due to the one mode of carbonization or the other.

Mr. Wallace stated that the ore was a carbonate of iron, or a protoxide of iron and carbonic acid united, and not a carburet of iron (or iron and carbon simply), as was generally believed. In smelting, the carbonic acid was driven off, the simple oxide remaining; the oxygen of which, being carried off by the heat, left the pure iron, which, combining with the carbon of the coke, formed a fusible carburet of iron, or the pig-iron of commerce.

Mr. John Taylor observed that his brother, Mr. Philip Taylor, being sensible of the advantages to be expected from the use of anthracite in smelting iron, made a series of experiments several years ago, from which he derived the opinion that the carbon absorbed by the metal, and which is necessary to produce it in the shape of pig iron, must be presented in a gaseous state to the mass in fusion; and as anthracite did not afford a sufficient supply of coal gas during combustion to produce the proper effect, he proposed to adopt a very ingenious method, by which this gas would have been thrown into the furnace in such proportions as might be found necessary, mixed with the common air employed as the blast. Circumstances interrupted the course of these experiments, or it is possible that the use of anthracite for this important application might have taken place at a much earlier period than it has happened to do.

Feb. 15.—The President in the Chair.

"*Description of Chelson Meadow Sluice.*" By Theodore Budd, Grad. Inst. C. E.

The sluice which is described in this communication was erected from the designs of Mr. Rendel, for the Chelson Marshes in Devonshire, which, being very low, had previously suffered much from floods, but now are entirely relieved. The novelty in the construction consists in hanging each of the doors respectively by two hinged flat bars of iron, of 18 ft. 6 in., and 15 ft. 3 in. in length, and thus, by placing the centre of motion so high above the centre of gravity of the doors, give greater freedom of action than by the modes usually adopted in similar works. The dimensions of all the parts, and the method of construction, are given in great detail, and are illustrated by a drawing.

Remarks.—Mr. Rendel explained that the sluice doors which had been superseded by those described by Mr. Budd, were of the ordinary description, placed side by side. They were frequently hinge-bound and clogged up; which caused the land to be flooded sometimes for three months during the year; the hinges were attached in the usual manner to the frames, close at the head of the doors, and they required a pressure of at least 6 inches of water to act upon them either way. He considered the principal advantages of these doors to consist in the freedom of action given by the length of the bar hinges by which they were suspended, their giving the full extent of opening, and the pressure of one inch head of water sufficing either to open or close them.

Mr. Prior inquired whether there was any similarity between these sluice-doors and that erected by the President near Blackfriars Bridge, at the bottom of Fleet Ditch, That door was so well hung as to be even acted upon by the wind; and the slightest pressure of water sufficed to open or to close it.

The President explained that the principle was not the same; at the Fleet Ditch sluice double hinges were used, or rather hinges with a link between the part attached to the frame, and that which was screwed to the door;—that form of hinge always acted freely, and allowed the doors to open with a slight pressure.

"*On the mode practised in India for obtaining solid Foundations for Bridges, &c., in sandy soils, by means of Wells.*" By Captain Goodwyn, B. E., Assoc. Inst. C. E.

Piling for the foundation of buildings appears to be entirely unknown in Hindostan; the ordinary mode for securing a foundation, where the superstratum is tenacious and rests upon loose sand, is to dig a well until water is reached; a curb of timber is then placed, and upon it a cylinder of brick, 7½ feet exterior, and 3½ feet interior diameter, is built to the height of 3 or 4 feet above the ground. As soon as the masonry has hardened sufficiently, the well-sinker fixes a plumb-line to the top of the cylinder as a guide, and descends withinside, carrying an instrument called a "Phaora, or Mamooti," somewhat similar in shape to a hoe; with this he excavates the earth until the water is too deep; he then commences the use of the "Jham," which resembles the "Phaora" in shape, but is about 36 inches long and 27 inches wide, and is suspended to a cord passing over a pulley above the cylinder. Upon this instrument the well-sinker descends, and diving into the water excavates with the "Jham" the soft earth under the sides of the curb, and is at intervals drawn up with the instrument. The cylinder descends gradually from 6 inches to 2½ feet per day, as the earth is withdrawn from beneath it, and relays of workmen keep it constantly going, lest the sand should settle around it, and cause it to hang up. The natives are very expert in this operation, and not unfrequently remain under water more than a minute at a time. The cylinders have been sunk as deep as 40 feet; but with extreme labour.

A series of these wells being sunk at intervals of 1 foot between them, they are filled with a grouting of lime and rubble-stone, and separately arched over; arches are then thrown transversely from the centre of each parallel pair, and another set of arches turned over the adjacent wells longitudinally; the whole is then covered with masonry, and the pier or other building raised upon it: such foundations are found to answer perfectly in situations where almost any other kind would be washed away.

The communication was accompanied by a drawing of the process, and of the tools used, showing also the modification of the system proposed by Colonel Colvin, of the Bengal engineers, for obtaining foundations for a curtain, or line of wall, by sinking square masses of brickwork, with two or more wells in each, through which the workmen could excavate the soil.

In answer to questions from the President, Captain Goodwyn observed that the greatest peculiarity of this system was that the sinker worked under water; such had been their custom for ages. Upon this kind of foundations many of the large fortresses in India were constructed, and they stood remarkably well; whereas, if timber piles had been used, the white ant would have destroyed them in a short time.

Lieutenant Sale observed that another main reason for not using piles was, that timber was scarce and dear, whereas labour was plentiful and cheap. Hence the general use of the brick cylinders.

Mr. Parkes conceived the most ingenious parts of the proceeding to be, the sinking through the water, and thus avoiding the risk of bringing up large quantities of sand, and the combination of arches, for distributing the weight of the superstructure equally among the brick shafts. Such shafts had been used by the Chinese, and sunk in the same manner from time immemorial.

In answer to a question from the President, Mr. Simpson described the process now so much practised for sinking wells through bad strata by means of cast-iron cylinders; excavating the earth from within the cylinder by an instrument called a "miser," which is a conical iron shell with a valve opening inwards; it is suspended by iron rods 1¼ inch square, and worked from the level of the ground without pumping up the water: it is not uncommon to excavate to a depth exceeding 100 feet in that manner. The "miser" can bring up a cubic yard of earth each time it is raised. Cast iron cylinders are preferable to brick shafts, which frequently hang up, and in that case give much trouble, whereas if the iron cylinders do not descend freely, they will bear the application of considerable force to drive them down. They are frequently forced through the indurated ferruginous gravel. Light planking is also sometimes used, particularly in such cases as in the well he is now sinking at Chelsea, which is 20 feet square, lined throughout with 3-inch planking. It has reached the quick sand at a depth of 32 feet, and will be stopped there.

Mr. Davison had just completed a well at Messrs. Truman and Hanbury's brewery, with cast iron cylinders, 8 feet diameter, and 193 feet deep, an account of which he promised to present to the Institution.

The President was now sinking a set of cast iron cylinders through sand which was liable to be washed away; they were to be filled with concrete and used as the foundation for a lighthouse at the Point of Air. An account of the construction was, he believed, preparing for the Institution.

"*An Historical Account of Copper Sheathing for Vessels.*" By J. J. Wilkinson.

The two former papers by the same author,* treated of Wood and Lead Sheathing for Ships: the present communication gives in the introduction a general account of Copper as a metal; the localities supplying it; the uses to which it has been applied, from the earliest period to the present time; and the relative estimation in which copper of various countries is held on account of its degree of purity, its ductility, or its better preparation, in which latter particular British copper is stated to be pre-eminent.—An epitome is then given of a return to the House of Commons; whence it appears that in 1832, into Swansea alone, there was imported 4350 cwts. of unwrought metal, and 419,604 cwts. of ore, and that there was exported during the same year, of British metal, 153,742 cwts., and foreign metal 112,830 cwts. Copper from Sweden is considered more malleable than that from Hungary; but the former is not so good as British metal, as it contains a portion of iron.

Copious extracts are made from "Knowles's Naval Architecture," whence is quoted the first recorded use of copper sheathing upon the "Alarm" frigate, in 1761; at that period it was believed that sea water had little action upon pure copper, and the rapid decay of the partial sheathing of certain ships was attributed to the impurity of the metal. Experience showed, however, that pure copper, like that employed on the "Tartar," could be destroyed in the short space of four years, while the sheathing of the "Batavia," an old Dutch man-of-war, and of the "Plymouth" yacht, was perfect after 24 and 27 years' service; in both the latter there was an alloy of $\frac{1}{300}$th part of zinc.

Much information is given on the rolling of copper sheets; the dimensions; the weight per square foot of different gauges, and the uses to which the various kinds are applied: as also on the quantities of metal used for sheathing. The "Neptune," of 120 guns, was cased with 4738 sheets, weighing altogether 17 tons 19 cwts.

The use of copper sheathing is to protect the wood from destruction by the worm, and to prevent the adhesion of weeds, barnacles, &c. which impede the sailing of the vessel. On the first introduction of copper, it was used in conjunction with iron bolts and other fastenings; these soon oxidated, and serious accidents occurred. It was advised in consequence that all the bolts should be of copper or mixed metal. The attention of the Government was directed to the subject, and Sir Humphrey Davy was appointed to experiment upon specimens of metal of different qualities. He soon discovered that when two dissimilar metals are in contact and immersed in sea-water, a voltaic effect is produced which occasions a rapid corrosion of the more oxidable metal, while the other remains uninjured. In 1824 Sir Humphrey Davy communicated to the Government that he had discovered a means of preventing the corrosion of the copper by rendering it electro-negative. This he proposed to effect by protectors of zinc, iron, or any other easily oxidable metal: after a variety of experiments he determined that the protectors should consist of six bars of cast iron, whose united surface should be $\frac{1}{250}$th part of the area of the copper exposed to the action of the sea water: two of them were placed midships on the keel of the ship, two on the bows, and two on the stern about three feet under water. As far as the philosophical fact was concerned, the result was conclusive, as the copper suffered no waste. Inconveniences, however, arose which had not been foreseen: as the copper did not oxidate, its whole surface was speedily covered with barnacles and sea weeds, which collected in such quantities as to impede the sailing of the vessels, and adhered so fast that in removing them the copper was frequently torn away: the protectors were therefore abandoned, in 1826, for all vessels on service, but were still used for the ships lying up in harbour; the bottoms of these became, however, so foul, that in 1828 the system was entirely abandoned. After the protectors had been for some months on the ships' bottoms, it was found that on the outer surface a red oxide was formed, and beneath it, for some depth, a substance resembling plumbago; this substance, having sulphate of iron for one of its constituents, when laid upon any inflammable body, caused spontaneous combustion: a similar result was obtained by Mr. F. Daniel in 1817, while experimenting upon cast iron, by solution in dilute muriatic acid. Protectors of various kinds have been tried in the French navy, and in the United States; but generally with doubtful success.

A list of all the patents for copper and other sheathing, as well as means of preventing corrosion, &c., is then given at great length: the gradual progress of the application of copper sheathing, first to ships of the Royal Navy, then to Indiamen, to Transports, and finally to Merchant Ships, is then traced. It appears that of the vessels which enter the Thames, one-fifth are sheathed with copper and its alloys; of vessels at Liverpool, eight-tenths are coppered. The precautions for preserving uncoppered vessels from the "Teredo navalis" are then described: and coal-tar pitch is mentioned as the most effective substitute for sheathing.

Copper sheathing appears to be entirely neglected for vessels in the coal trade, although it is singular that the "Teredo" is found in every port to which coals are carried, south of the Tees; in the Thames, as high up as Gravesend, and northward as far as Whitby; traces of the ravages of the "Teredo navalis," and of the "Limnoria terebrans," have at various periods been found, from the north of Scotland and Ireland, on almost every coast to the Cape of Good Hope and Van Diemen's Land, in the Eastern hemisphere: and in the Western hemisphere, from the river St. Lawrence to Staten Island near the Terra del Fuego, almost in the Polar Sea; so that although this maritime scourge is rifest in warm climates, yet cold latitudes are not exempt from it.

Remarks.—Mr. Lowe was pleased to find that the use of coal-tar pitch for shipping was advantageously mentioned: he was convinced that it would be found very superior to vegetable pitch: he had seen comparative experiments tried on board an India ship, and the result was, that the timber which had been coated with the former was preserved both from the worm and from decay, while that which was covered with the latter had suffered from both. He attributed the preservative quality of the coal-tar pitch to the quantity of sulpho-cyanic, or sulpho-prussic acid, which it contained.

Mr. Horne had used coal-tar extensively on wood, but found that it produced decay, which he attributed to the ammonia contained in it.

Lieutenant Oldfield alluded to Renwick's patent. for saturating timber with coal-oil: he had seen specimens of piles at New York, which, when prepared by Renwick's process, perfectly resisted the attacks of the "Teredo navalis," in the same situations where "kyanized piles" had been entirely destroyed.

Mr. Bethell confirmed Lieutenant Oldfield's statement. Coal-oil was a powerful preservative when properly prepared and applied: he objected to the use of ammonia in any shape, as it rotted timber very fast. In experiments he had made, previously to taking out his patent for preparing timber with coal-oil, he observed that wood coated with common coal-tar soon turned brown, and decay ensued: ammonia produced the same appearance and effect. If any vegetable fibrous substance, such as peat, was sprinkled with ammonia, it speedily rotted, and became a rich black earth. In the Mediterranean, the native ship owners used nothing but coal-tar pitch for their vessels; they were cleaned and well tarred twice a year, and the worm seldom made any ravages, although unprepared timber in those latitudes was destroyed in a very short time. The refined coal-tar, as manufactured in London, is purified from ammonia by distillation. and found an excellent coating for wood. The oil of tar, used in Mr. Bethell's process, is likewise purified from ammonia.

Mr. Parkes conceived that diluted ammonia must be meant as recommended for agricultural purposes, and not the ammoniacal liquor as it came from the gas-works; the former, when used with discretion, properly diluted, and to certain soils, was an active stimulant in cultivation, but the latter contained matter which was very prejudicial.

Mr. Bethell observed that ammoniacal liquor, when diluted with three parts of water, had been found to succeed perfectly with peaty soils. Nearly all the sal ammoniac of commerce is now made from the ammoniacal liquor from gas-works.

Mr. Hawkins remarked, that it could be readily understood that the proportion of ammonia used would regulate the effect to be produced; as in the case of gypsum, of which two bushels per acre was a good manure; but in some places fifteen or twenty bushels per acre had been tried, and of course a complete failure had ensued.

Mr. Parkes replied, that gypsum was commonly used in Yorkshire, and habit had dictated the proportions so well that it seemed to be the best manure the farmers possessed there.

Mr. Taylor recalled the conversation to the subject of the Paper on Copper Sheathing; from which many curious facts might be drawn. The ancient specimens of copper sheets had endured longer than the modern: the former contained an alloy of $\frac{1}{300}$th part of zinc. The "Muntz" metal, which is now being extensively used, contains alloy of the same material, but in a larger proportion. The inequality of manufactured copper had perplexed the chemist and the manufacturer for full forty years; and after all their researches and experiments, it would appear that the chemistry of the manufacture of copper and of iron was not understood. Mr. Taylor had been consulted by Sir John Henslowe on the subject, and he had recommended assaying the sheets instead of receiving them by the appearance of their surfaces, as was the usual mode. Dr. Faraday and Mr. Richard Phillips had made an extensive series of experiments for Mr. Vivian, and Mr. Farquhar had carefully analysed various specimens; but all these eminent men failed in discovering any chemical difference between the copper which had endured well and that which had been rapidly destroyed. Sheets of copper rolled the same day, under apparently similar circumstances, differed materially in quality. In the process of "polling," which is carried on by stirring about the copper while in a fluid state with poles of green wood, producing ebullition, whether the operation is continued too long or too short a time, the metal becomes brittle, and the quality cannot be recovered. Less copper is now exported from Russia, because the attention of the miners is directed to the gold mines. Mr. Taylor attributed the superiority of the quality of the foreign copper to the ore being smelted with charcoal; whereas English copper is smelted with bituminous coal, frequently containing sulphur.

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* Minutes of Proceedings, vol. 4, for 1841, pp. 318 and 357.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

April 18.—This meeting was attended by the President, Earl de Grey, who, having left his vice-royalty to attend to his parliamentary labours, took the opportunity of being present. The attendance was most numerous.

A paper was read by Mr. Hosking upon "*The Composition and Construction of Bridges*," the conclusion of which was obliged to be reserved for another meeting, on account of the other business of the evening. After the lecture his Lordship addressed the meeting, alluding to the happy union of the two societies, which had always been an object of his earnest wishes. The articles of union were, he said, satisfactory and advantageous to both societies, and the Institute had received an accession to its collection of a large number of valuable plans, drawings, casts and books. He also adverted to the accession of H. R. H. Prince Albert as Patron of the Institution, and then stated that he had a pleasing duty to perform in presenting the Soanean medal to Mr. J. W. Papworth, Associate, for his design of the restoration of Crosby Hall. It afforded him, he said, additional pleasure to present this medal to that young architect in the presence of his father, who was one of the oldest members of the Institute; and had the good fortune to see his honourable career followed up by his son. In addition to the medal there was a sum of 10 guineas presented by Miss Hackett, the owner of Crosby Hall.

After the conclusion of the business of the meeting there were some beautiful specimens of Keene's cement exhibited, consisting of inlaid paving in various colours, capitals of columns, and other applications of the material for architectural purposes; they were presented by Messrs. White & Son. A specimen of Caen stone was laid on the table; the price stated at which it could be delivered on the Thames was 1*s*. 10*d*. per cubic foot.

ACADEMY OF SCIENCES.

Feb. 28.—M. Dufresnoy read a report on some researches by M. Paillette upon *the metalliferous districts of Calabria*, and the north of Sicily. It appeared that the mines now worked in those districts were not opened previous to 1720, and that before this period the mineral riches of the countries in question had been very imperfectly known to, or at least little used by, the inhabitants, and even the Romans. It was about 1720 that some German miners were employed by Charles VI. to look for metallic veins; their operations assumed a certain degree of importance about 1753; but thirty years later they were almost entirely abandoned. Most of the metalliferous formations of southern Italy consist of small veins, resembling those of Auvergne and the Limousin. Tables of the quantity of metal produced by the various mines now worked accompanied these researches.

A memoir was read by M. Combes, on *the sulphureous hot springs of Hamman-Escoukin, near Bona, in Africa*. They burst forth on a small plateau, which is covered by a white crust of the mineral matter deposited by their water, and they form round each orifice small cones, from the summits of which the water flows. Their average heat is from 78 to 80 degrees of Reaumur, or from 207½ to 212 Fahrenheit—boiling point. It is only 200 or 300 paces from the spot where the waters of these springs join a mountain stream of cold water, that their heat becomes reduced enough to allow of people bathing in them. They are highly sulphureous, and send up immense clouds of steam. The numbers of people who resort to them for all kinds of complaints are considerable.

March 7.—M. Arago informed the Academy of the result of some observations, lately made with great care, for ascertaining the exact height of the summit of the lantern of the Pantheon above the lowest point, or zero, of the water scale at the Pont de la Tournelle, and also the exact height of the latter point above the level of the sea in the Channel. It appeared that these heights were 117 mètres 60 centimètres, and 25 mètres 76 centimètres (or 385 ft. 10 in. and 84 ft. 6 in.) respectively. M. Arago stated, the object of this was to serve for the settlement of the exact levels of all points of the capital, with a view to a more accurate system of drainage; and further, that the Municipal Council had decided on having the altitude of the soil, above the zero of the scale at the Pont de la Tournelle, marked at a very great number of points in the capital, and engraved on plates, which would be affixed to public buildings or houses of a certain solidity of construction, at the points where the altitudes would be taken.

M. Beautemps-Beaupré laid on the table the 5th part of the great hydrographical survey of the French coast, on which he has been occupied several years. Captain Berard presented the Academy with the general table of observations made on board the *Uranus*, during the late voyage to and from the Island of Bourbon. They related principally to the temperature of the ocean.

M. Chazaillon communicated some researches on tides, and the level of the ocean. He had found that the analytical expression, used by Laplace, for calculating the height of the tide was incomplete.

M. Francœur read a paper on a new instrument, constructed by himself, for measuring the strength of distilled liquors.

A model was exhibited to the members by M. Sorel, for fixing zinc on iron by a new application of the voltaic pile.

March 21.—A communication was read from M. Amédée-Durand, "*On a New Mode of Constructing Windmills*." The invention of M. Durand consists chiefly in imparting to the sails of the mill their impelling force in a way resembling that which is experienced in the mode of sailing a vessel. The action of the wind striking from behind bears upon a point beyond the centre of the pivot, and tends to keep the shaft in a parallel direction with the current of air, the sails being constantly maintained at a right angle with the wind. By this new system the sails, which are six in number, are not, like those of the common mills in use, supported upon framework, but are attached and spread in the same manner as those of a vessel. They are so disposed that their whole surfaces may be acted upon so long as the wind, augmented in effect by their total surface, is inferior to the weight of a counterpoise, which tends constantly to keep it in its normal position. When the wind exceeds this limit, the counterpoise comes into action, and so changes the quantity of surface exposed, that the machinery may continue to perform its functions without any acceleration of motion beyond what is requisite. M. Durand states that his invention has been submitted to the test of experience, several mills so constructed having for years past been in operation, and effectually resisted the most violent storms.

March 28.—*A report, by M. Chevreuil, was read, on a paper, by M. Ebelhelm, respecting the manufacture of iron.* M. Ebelhelm's paper was principally on the construction of blast-furnaces, &c. M. Ebelhelm states that he is satisfied, from a series of experiments, that the present mode of constructing furnaces is as near to perfection as possible, but that nearly two-thirds of the combustibles employed pass off in gas, and that there would be great economy and advantage in a contrivance for preserving this gas, and making use of it in the process of smelting. The paper, however, leaves the question of the precise and best mode of obtaining this result still doubtful.

A paper, by M. Gaudin, on photographic drawing, was read. This gentleman announces, that he has succeeded in obtaining perfect impressions, and more rapidly, without the use of the iodine-box, by exposing the plate to the action of a single compound of iodine, of his own preparation, much richer than what is now used in the uncertain photographic apparatus of the iodine-box.

M. Viau communicated to the Academy a new mode of raising vessels sunk in deep water. His apparatus consists of a covered, but light and air-tight frame work, which he calls the *hydrostat*. The process is commenced by allowing the water to rush in and fill the *hydrostat*, which of course sinks until it reaches the object it is intended to raise. The valves are now closed, and the apparatus fixed by means of chains or ropes to the vessel. A stop-cock, connected with a pipe, is opened, and this pipe communicates with two recipients on a stage, or platform, erected on a boat, or vessel, near the spot. One of these recipients contains an acid, and the other carbonate of lime, and a communication between them is established, so as to keep up a sufficient supply of carbonic acid gas, which passes through the pipe into the *hydrostat*, and displaces the water. The *hydrostat*, now filled with a light gas, will naturally rise to the surface, if its volume be large enough to drag with it the body to which it is attached.

[The following words were, by accident, omitted at the conclusion of our last month's Report, p. 137 :—" be effaced also, and the forgery detected."]

Art-Union Society.—The annual meeting for the distribution of prizes was held at Drury Lane Theatre, on Tuesday, 26th ult., when a most interesting report was read, we believe from the pen of Mr. Godwin, and from which we learn that there are 11,119 subscribers and the amount of subscriptions is £12,905. The house was crowded to excess, and many hundreds were forced to go away for want of room. In consequence of the absence of the Duke of Cambridge, the chair was taken by Mr. Benjamin Bond Cabbell. The prizes distributed were 240 in number, varying from 10*l*. to 400*l*. We regretted to observe that there seemed a disposition to stifle inquiry, for when one or two members rose to ask some very necessary questions, they were immediately checked; as, however, only one meeting is held in the year, we think that some facility should be given to subscribers to ask for public information; it is the only way to prevent abuse creeping into the proceedings of so useful an association.

The Anti John Scott Russell.—We have witnessed the surprising performance of this small vessel, fitted with Beale's patent rotary engine. The speed of the boat averages upwards of 10 miles per hour, although the engine is little larger than 18 in. diameter, and 12 in. broad. We had intended to have given the drawings of the engine and boiler, together with some particulars of its construction, and the quantity of fuel consumed; but we have deferred doing so until we have had another opportunity of witnessing the performance of the engine. To all who feel an interest in the rotary engine we recommend their attention to that of Mr. Beale: it is extremely simple, and cannot easily get out of order.

REVIEWS.

A Treatise on Fresco, Encaustic, and Tempera Painting. By EUGENIO LATILLA, Mem. Soc. Brit. Art. London: 1842.

IN the artistic movement which has been communicated to architecture, the discussion as to the best mode of decorating the New Houses of Parliament has been one of the main features. Here we find two parties formed—the architects having declared themselves for the introduction of mural decoration, and the artists opposing it, or admitting only of oil painting as the proper medium. The architects look upon this subject as not only likely to give a more artistical tendency to their art, but as promising to elevate art itself. To this are opposed the large body of the artists, who, devoted to portrait, landscape, or conversation subjects, having but a limited view of their own art, and being incapable of estimating that of others, and being above all things ignorant of fresco, reject in the strongest terms either the applicability of this medium, or the utility—nay, even possibility—of the existence of high art. They know that the intimate acquaintance with the human form, the breadth and grandeur of outline, and the firmness of touch, required for fresco, are qualifications which their previous studies have denied to them; accustomed also to compose on a small scale, they fear the gigantic efforts of historical art. To such an extent does this ignorance, do these prejudices prevail, that we firmly believe, that did the fate of the decoration of the Houses of Parliament depend on the fiat of the Royal Academy, that by a large majority all idea of it would be rejected. This feeling is to be regretted, as it will tend but too strongly to fortify the inclination for German artists, already manifested by some members of the Royal Commission; for if English artists declare that they cannot execute fresco, the Commissioners will naturally turn to the Bavarians, who are but too ready to assert their proficiency. Under such circumstances it is to be expected that the most exaggerated and unfounded statements with regard to fresco have been given out, which are so ably met by Mr. Severn in another part of the Journal, that we do not think it necessary ourselves to refute them. If they think that with so many examples before their eyes in the public buildings of London, that the Commissioners will ever trust to oil as the vehicle for decoration, the artists are most grievously mistaken. Its blackness its varnished, surface, its partial effect, and its perishability, would alone suffice to ensure its rejection, and throw us upon the mercy of the whitewasher, or of the carver and gilder. Fortunately, however, the question does not depend for determination upon the artist: the architect has his vote. The artist on this occasion is only the subordinate; and mural decoration is a question which has come within the attributions of the architect from the earliest period. The architect will, upon turning to Vitruvius, find the instructions and mechanical details which, the same in principle and practice, prevailed in the classic period and in modern days; he will find that until the artist commences his work on the wet plaster, the whole matter is exclusively in his hands; and that even then it is his duty to direct and supervise, to see that the harmony of the design is maintained, and that the several parts are correspondent to the whole. Fortunately also, the architect is well qualified to judge between the respective media. He will look to their general effect, to their durability, to their capability of harmonizing with his own labours; and it becomes no question as to preference between the marmoratum with which fresco is incorporated, or a scaly covering of decomposing oil. If the Houses of Parliament are to be decorated at all, it is evident it must be by fresco or encaustic, or not at all; and we beg our readers not to be diverted from the right course by any clamour or misrepresentations of the artists, but to judge for themselves.

When this question was first agitated, it was the general impression that we must either fall back on the Germans, or commence from the rudiments a new school of our own. The result, however, has been to show that we have many artists already practically versed in fresco; and many others have since made themselves acquainted with it. Among those who have practised this art, two are to be distinguished. The first is Mr. Parris, who has long devoted himself to it, and whose views on the subject have been communicated to the Institute, and published in our Journal; and the second is Mr. Latilla, late President of the Society of British Artists, also an old practitioner in this country, and student in Italy, and author of the work before us. Among other artists who have publicly given their countenance to fresco, are Mr. Haydon, who has availed himself of the instruction of Mr. Latilla; Mr. Severn of Rome, the friend of Keats the poet, and author of the valuable discourse on mural decoration which we insert in our present number; Mr. Baker, of Bath; Mr. Bell, of Manchester; and Mr. Lane; the latter of whom are all practically acquainted with it. We learn also on Mr. Haydon's authority, that the late Sir David Wilkie was an advocate for fresco, having twenty years ago recommended the former artist to apply himself to it. Those who wish to see some account of the labours of these artists, will, in some of our recent volumes, find descriptions of works both by Mr. Latilla and Mr. Parris.

The work to which we now wish to direct the attention of our readers, we must warn them beforehand is to be studied Hebrewwise—from the end—for Mr. Latilla has unfortunately tacked to it some preliminary chapters, which, not being copious enough to enter into the whole history of the art, come on the ear with all the weariness of common-places. The reader must therefore plunge *in mediis*, and he will there find a good description of the practical part of mural decoration, which, although meagre, is sound in its teachings. Mural decoration is of four kinds—fresco, encaustic, tempera, and kalsamine; to the last of which, although certainly of little importance, we see no allusion in Mr. Latilla's work. The first consideration in all cases is to be directed to the stuccos, of which there are three layers requisite for fresco. The first process Vitruvius calls Trullisatio, or rough plaster, and was performed by the Romans with a plaster of 1 part lime, 2 parts rough river sand, and 1 part pounded brick and tile. The second process is named Arenatum, or sand mortar, the Roman composition of which was 1 part lime and 2 parts river sand, of which they used three successive coats, each laid on while the preceding one was damp. Much depends on the Arenatum being well prepared: if only one layer be used, the plaster will be liable to crack and decay. For the Arenatum, the Italian fresco workers of the fifteenth century sometimes used pozzolano mixed with Trevertine lime, in the proportion of 2 of lime to 1 of pozzolano; and Mr. Latilla says that he has used with great success good Roman cement and stone lime, which he has found to give a firm basis to work upon, and greater brilliancy to the colours. The third process was called Marmoratum, or marble mortar, being composed of 1 part lime and 2 parts marble dust, of which three thin coats are laid on in different degrees of fineness, the coarsest first. It must be so tempered as in working not to adhere to the trowel, but to leave it clean and free from mortar. There is a difference between this and the Arenatum, for each layer of the Marmoratum should be allowed to dry before the succeeding one is applied. If the layer of Marmoratum should be single only, the plaster will be apt to crack and scale off, and the design will be deficient in brilliancy. The thickness of the several layers of plaster in the Baths of Titus is about an inch and a quarter, but the Italians diminished this thickness in their works, to the serious prejudice of their durability; neither did they pay such attention as the Greeks and Romans to the proper working of the mortars.

Having for the present dismissed the architect, we have to consider the duties of the artist, to whom Mr. Latilla, as it seems, paradoxically recommends to paint in all the ornament first; but he appears, on reflection, to be in the right, assigning as his reason for this recommendation, that it is easier to harmonize subject to ornament than ornament to subject, the subjects also being intrusted sometimes to different artists, so that the arabesques form an excellent key for the tone and colour of the historical painter. For every part cartoons must be prepared of one or two layers of thick paper, on which the design is sketched with charcoal, and then painted in tempera with colours. This outline is transferred on the walls, usually by tracing the cartoon with an etching point; but this always leaves furrows on the stucco, and Mr. Latilla recommends in preference pricking out the outline with an etching needle, and then pouncing it with charcoal powder on the fresco. A portion of the outline being traced or pounced on the wet stucco, the painting begins, which must be executed in sections, as a head or a limb at a time, and each part rapidly, so that the colours may incorporate with the lime: no retouching can be allowed, with due regard to effect. The arabesques having been painted in, Mr. Latilla prescribes that the blank cartoons should be fixed in their respective situations, and then the general design to be sketched in, as a better judgment can be formed of it when up. Again, when all the cartoons have been drawn, he recommends that they should be affixed in their positions, so that the full effect of the whole may be seen; a measure which is necessary when several artists are employed, and which shows what alterations and improvements are required to harmonize the whole. The whole work, we say, and the general superintendence of it, should be committed to the architect, who is the party responsible for the entire effect, and who is best aware of what agrees with his design.

Encaustic, one of the most ancient methods practised by the Greeks, is a particular favourite with Mr. Latilla. Of the ancient practice but little is known, and, we are sorry to say, that of its modern applicability as little.

Mr. Latilla, with much apparent reason, seems to think that it was executed with a mixture of wax and oil; and he has applied this mixture with success in the banquetting-room of the Duke of Beaufort's mansion, in which he has happily united the freshness, brilliancy, and freedom from glare of fresco, with the richness and facility of oil. Mr. Latilla's process is a good one, and one deserving of greater extension; but we do not think that it is the ancient encaustic, if, indeed, the discovery of the true encaustic be not a chimera which, if found, would not be worth the finding. From all we have seen, we fear it would be so.

Tempera was practised by the Egyptians and the Greeks, and also in the English cathedrals; and, according to Vasari, was executed with yolk of egg mixed up with the milky juice of the fig-tree, and then used with colours ground up in water. Mr. Latilla says that the fig-tree juice is not essential, but that we have a substitute for it in the spurge or wartwort, which yields a milky juice applicable for the purpose. Kalsamine is tempera with a conservative surface; but neither of them are so durable under the operation of the atmosphere as fresco and encaustic.

Mr. Latilla mentions a curious circumstance with regard to fresco, that in the course of drying it frequently exhibits an alarming appearance, the colour looking patchy and faint, and a white mould rising to the surface. In the course of two or three months, various changes succeed each other till the picture almost entirely disappears; but as the plaster dries, it shows itself with more than pristine beauty. Michael Angelo was so troubled with this phenomenon while painting the Sistine Chapel, that he was about in disgust to throw up the work, until he was assured by Julian da San Gallo of the temporary nature of this operation, and the causes of it.

A great many experiments are now being made as to the best materials for cement; and we understand that Mr. Alfred Francis, in the course of a long investigation on this subject, has even succeeded in getting mural painting to withstand the operation of the atmosphere. The subject is important, and we hope the results of these experiments will be communicated to the public.

A Manual of the Steam Engine. By Richard D. Hoblyn, A.M., Oxon. London: Webster and Geary, 1842.

We should be glad to know for what class of readers Mr. Hoblyn's book is designed. The professional engineer can hardly be supposed to be edified by an *omnium gatherum* of the most trite and superficial remarks on steam of the last half century, and the general reader has nothing further to desire after the admirable popular treatise on the steam engine by Dr. Lardner. There is no redeeming quality about Mr. Hoblyn's book. He does not treat of any new branch of inquiry connected with the steam engine, nor of any new application of steam power. He has adduced no new facts, supplied no new investigations; he has neither shortened nor simplified any pre-existing analysis, nor stated more felicitously the nature of any particular movement, agency, or combination. The only thing he has succeeded in showing is, that a man may set up for an instructor without any tolerable acquaintance with the subject he professes to teach. A popular treatise upon the steam engine is a complete superfluity, unless its merits be transcendant. Mediocrity is unpardonable where great excellence has already been attained; and Dr. Lardner's treatise is a standard which it is fatal to come short of, and hardly possible to surpass.

An Account of Patent and other Methods of Preventing or Consuming Smoke, &c. By William West, Professional Chemist, Leeds.

This pamphlet is a collection of various schemes for consuming or preventing smoke, as promulgated by the several projectors at a public meeting held at Leeds in January last. It is difficult from such a heterogenous mass of materials to analyse them without entering into the merits or demerits of each, which would occupy the whole of our Journal for the next three months, we therefore refer our readers to Mr. West's pamphlet, and let them judge for themselves; however, we cannot allow this notice to pass without observing that too much praise cannot be awarded to Mr. Eddison, the spirited individual who called the meeting together, and who has devoted so much of his valuable time and labour to an investigation of the subject. It does not appear that the committee who met to consider of the several plans submitted, or Mr. West, the compiler of the pamphlet before us, have come to any determination as to which of the various plans is the best, and have, like ourselves left it to the public to form their own opinion.

Height of Paris above the Level of the Ocean.—It appears, from geodetical operations and direct levelling, that the zero of the hydrometic scale at the Pont de Tournelle is 26·25 metres above the mean level of the ocean.

THE ATMOSPHERIC RAILWAY.

Sir—I am of opinion that the annexed passages, taken from the report to the Committee of Privy Council on Atmospheric Railways, by Col. Sir Frederick Smith, R.E., and Professor Barlow ought to be placed together to enable the public to appreciate the value of one of the conclusions given at page 6 line 1 of their report.

"Secondly, the expence of the formation of the line in cuttings, embankments, bridges, tunnels and rails, will be very little less than for equal lengths of railway to be worked by locomotive engines; but the total cost of the works will be much greater, owing to the expence of providing and laying the atmospheric tube and erecting stationary engines."

The latter part of the conclusion refers to Samuda's estimate of £4000 for single and £7000 for a double line for the atmospheric apparatus for impelling the trains; but the question whether a less expensive line might not be formed by means of steeper gradients, worked by a proportional vacuum, appears to be dependent on the working force of different vacuums, and it ought to be decided by the ratio of the increased cost of higher vacuums in comparison with the increased resistance of higher gradients, ——— and this subject is adverted to at page 4 line 11 of the report.

"In the pamphlets circulated by the patentees," credit is taken "for two important items, which we cannot altogether admit.———" Another questionable item is the reduced expence of cuttings and embankments, it being assumed by the patentees that not having to take the locomotive up a plane, much steeper gradients may be introduced than in present lines; that a great part of the power of a heavy locomotive is expended in overcoming its own gravity and resistance in ascending steep planes is certainly true; and it is equally true that on the atmospheric principle the whole additional force is exerted on the load itself. This is unquestionably an advantage, but still we think its importance has been greatly overrated."

At the bottom of page 5 the commissioners remark, "Having stated our own views, and having given in the appendix the experimental results and investigations on which they are founded." On referring to the appendix I find they state at page 11, line 1, "We were desirous, if possible, to ascertain the working force which different vacuums possessed of urging a train forward, but we failed of obtaining on this part of our inquiry any useful results, the engine not having sufficient power to preserve the vacuums constant."

The details of four experiments are then inserted, and it is added, "No conclusions can be drawn from these four experiments except that by the falling of the mercury, it is clear that with all the force thrown upon the engine, it was inadequate to the duty it had to perform."

I apprehend the case made out by the Report respecting a reduction of expence in the formation of the line itself, for an atmospheric railway, stands thus:—1st, the commissioners *think* the patentees have overrated the advantage that may be derived from the introduction of steeper gradients or portions of the line to be worked by a higher than average vacuum otherwise employed, and in the consequent reduction of the cost of the line. 2nd, that they admit the additional force of such increased vacuum is expended on the load itself. 3rd, that in consequence of the inability of the engine to preserve a constant vacuum, they were unable to obtain data for the determination of the limits within which the steeper gradients suggested by the patentees could be rendered available with the higher vacuums, or under what conditions the larger tube also suggested by the patentees for a low vacuum would be required on steeper gradients. 4th, that their conclusion, that a very small reduction of the expence of the formation of the line itself can be effected, is not founded on any evidence as yet submitted to the public, but rests on their own opinions. Time and trial must decide on the respective values of the assertions of the patentees and the thoughts of the commissioners. A jury, by the usage of this country, is directed to give the prisoner the benefit of a doubt. Commissioners, acting on different principles, report against an inventor.

Y

REGULATION OF CHIMNEYS.

Sir—On reading over the Act for the future regulation of Chimnies, with a view clearly to understand its intention, but which is not very easy, my attention was arrested by the observation "*or of greater length than four feet* OUT OF *the wall;*" and I have in vain tried to decide in my own mind what our legislators mean by it, as the flue must of necessity (as far as I can understand) be IN the wall; and why a less length than four feet should be exempt from the rule as to the size of the flue. Perhaps you, Sir, or some of your readers, will be good enough to remark on this in your next.

I have not heard whether the Architect's Institute have yet acted on your suggestion of September last.

I am, Sir,
Your obedient servant,
A Subscriber.

March 24.

[It appears to us that why the length of 4 ft. out of the wall is exempted, is to give an opportunity of introducing chimney shafts and pots with a contracted opening.—Editor.]

THE NEW TARIFF ON TIMBER, DEALS, &c.

The important change that is likely to be effected in the duties on the above articles has induced us to give the following information relative to the present and the proposed new duties; likewise a table which shows more immediately the differences between the old and new duties on foreign deals. We did not consider that it was necessary to extend the table to deals from British possessions, as the proposed new duties are so very trifling, and can be easily calculated from the cubical contents we have given of the various lengths of planks, deals, and battens in the table.

Present Duties on Timber and Deals imported into Great Britain from Foreign Countries and British Possessions.

	Foreign.			British.		
	£	s.	d.	£	s.	d.
Battens, *not exceeding 7 inches wide and 2¾ in. in thickness* per 120						
„ Ends, under 6 feet long	3	0	0	0	7	6
„ 6 ft. in length and not exceeding 16 ft.	10	0	0	1	0	0
„ exceeding 16 ft. and not exceeding 21 ft.	11	10	0	1	3	0
„ 21 ft. „ 45 ft.	20	0	0	2	0	0
Deals, above 7 inches wide and not exceeding 3¼ in. in thickness per 120						
„ Ends, under 6 ft. long	6	0	0	0	15	0
„ 6 ft. in length and not exceeding 16 ft.	19	0	0	2	0	0
„ exceeding 16 ft. and not exceeding 21 ft.	22	0	0	2	10	0
„ 21 ft. „ 45 ft.	44	0	0	4	0	0
„ exceeding 45 ft. or *above* 3¼ in. thick, (not being timber 8 in. square and upwards) per load of 50 cubic feet	2	10	0			
and farther per 120	6	0	0			
Timber, 8 in. square & upwards, per load of 50 c. ft.	2	15	0	0	10	0
Wainscot logs ditto	2	15	0	0	12	0
Oak ditto	2	15	0	0	10	0
Teak ditto				0	10	0
Mahogany per ton				4	0	0
Ditto from Honduras ditto				1	10	0
Balks, Ufers, and Fir Quarters, under 5 in. square, and under 24 ft. long per 120	18	2	7	3	5	0
Ditto 24 ft. long and upwards „	27	0	0	4	17	6
Lathwood, in pieces under 5 ft. in length, per fathom						
„ 6 ft. wide and 6 ft. high	4	5	0	0	15	0
„ 5 ft. and under 6 ft.	6	16	0	1	5	0
„ 8 ft. „ 12 ft.	10	4	0			
„ 12 ft. and upwards	13	12	0			
Firewood per fathom	0	19	0	0	0	10

Proposed New Duties.

	Foreign.	British.
	£ s. d.	£ s. d.
Timber or Wood—not being deals, battens, boards, staves, handspikes, oars, lathwood, ufers, or other timber or wood, sawed, split, or otherwise dressed, except hewed, and not being timber or wood otherwise charged with duty, the load of 50 cubic feet	1 10 0 From and after the 10th of Oct. 1843. 1 5 0	0 1 0
——— deals, battens, boards, staves, ufers, or other timber or wood, sawed or split, and not otherwise charged with duty——the load of 50 cubic feet	1 18 0 From and after Oct 10, 1843. 1 12 0	0 2 0
Firewood the fathom of 216 cubic feet	0 10 0	Free.
Lathwood ditto	2 0 0	0 1 0
Oars the 120	7 10 0	0 3 9
Teak the load of 50 cubic feet	0 10 0	0 1 0
Mahogany		
Wainscot		

The change in the timber duties will come into operation on the 10th of October, 1842.

Table showing the Comparison of the Present Duty and the intended New Duties on Planks, Deals and Battens from Foreign Countries.

	Contents. Cubic feet.	Present duty per 120.	Duty, from Oct. 1842, 38*s.* per load.	Duty, from Oct. 1843, 32*s.* per load.
120 Planks, 3 × 11		£ *s.*	£ *s.* *d.*	£ *s.* *d.*
21 ft.	577½	22	21 18 11	18 9 8
20 ft.	550	22	20 18 0	17 12 0
18 ft.	495	22	19 14 11	15 16 10
16 ft.	440	19	16 14 5	14 1 7
14 ft.	385	19	14 14 10	12 6 5
12 ft.	330	19	12 14 11	10 11 3
6 ft.	165	6	5 19 8	5 5 7
120 Deals, 3 × 9				
21 ft.	472½	22	17 19 1	15 2 10
20 ft.	450	22	17 2 0	14 8 0
18 ft.	405	22	15 7 10	12 19 3
16 ft.	360	19	13 13 7	11 10 4
14 ft.	315	19	11 19 5	10 1 7
12 ft.	270	19	10 5 2	8 12 10
6 ft.	135	6	5 2 7	4 6 5
120 Battens, 2½ × 7				
21 ft.	306 3 in.	11 10	11 17 9	9 16 0
20 ft.	291 8	11 10	11 1 7	9 6 8
18 ft.	262 3	11 10	9 19 5	8 8 0
16 ft.	233 4	10	8 17 3	7 9 4
14 ft.	204 2	10	7 15 2	6 10 8
12 ft.	175	10	6 13 0	5 12 0
6 ft.	87·6	3	3 6 6	2 16 0
All the above	per load of 50 feet		1 18 0	1 12 0
Timber	„	2 15	1 10 0	1 5 0

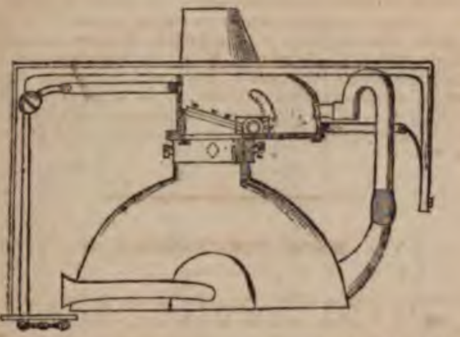
EXPLOSIONS OF STEAM BOILERS.

The calamitous accident which occurred lately in the Clyde has recalled public attention to this subject, and there can hardly be a doubt that unless means can be devised of rendering explosions less frequent, there will be some legislative enactment upon the subject. We should desire much to see the causes of explosions investigated at the instance and under the direction of the Steam Association, with the view of inducing the voluntary adoption of measures calculated to avert such disasters. The influence of example and the force of opinion would be productive of far greater amelioration than any legislative interference without giving rise to any of the confusion, irritation, and injury which such an interference would create. From a variety of circumstances which have come to our knowledge, we are thoroughly persuaded that the most prolific source of explosions is a deficiency of water in the boiler. There can hardly be a doubt that this was the cause of the late explosion of the Telegraph, in the Clyde, as well as of the Victoria in the Thames, and the Union in the Humber. Explosions generally take place just after the engines have been set to work after having been stopped for some time. In consequence of the inaction of the feed-pump whilst the engine is at rest, no water enters the boiler, and the quantity of water left in the boiler is rapidly diminished by evaporation until the water level falls below the top of the flues. The upper part of the flues consequently becomes red hot, and the rapid generation of steam or the decomposition of the water, immediately that the renewed action of the feed-pump sends a quantity of water upon the red hot plates, induces so great and so sudden a pressure, that explosion immediately ensues. The obvious remedy for this state of things is to furnish every boiler with a contrivance to maintain the level of the water by self-acting means, so that whether the engines are at work or whether they are stationary, the surface of the water in the boiler is preserved at a uniform height without the necessity of any alteration on the part of the engineer. It is perfectly possible to accomplish this by a suitable mechanism, and no vessel ought, we conceive, to be without some species of apparatus to attain this end. We have seen one contrivance which is not merely perfectly efficacious, but extremely simple, and which we would recommend to the notice of those interested in steam navigation. This contrivance is, we understand, the work of Mr. Robert Sinclair, of Gould Square. There may be other mechanisms that we know not of, equally efficacious, and the merits of all should be investigated and the best chosen. But whether viewed as a measure of safety in preventing explosions or fire from an overheating of the flues, or as a measure of economy in obviating the fearful expense so often arising from boilers being burnt, as is the technical phrase; we are strongly of opinion that some automatic feeding contrivance ought to be resorted to, and we can speak with much confidence of the merits of that particular contrivance we have alluded to.

PATENT VALVE CLOSETS.

Sir—I beg to solicit your attention to an improvement in the Valve (or Bramah's) Water Closet, patented by W. Beetson. Its decided advantage will be clearly seen from the following engravings.

A

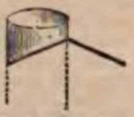


The Valve Closet is allowed by all scientific men to be the best in use: but from the fact of the valve of the common (or Bramah's closet) lying horizontally, unless the handle is pulled up all the distance, it only opens partly; and when opened the whole distance, the valve and axle are exposed to the paper, &c. catching upon it. By this invention the faults of the present closet are quite counteracted.

The principal improvement consists in the valve at the bottom of the basin being placed in a sloping position, which position allows the valve to open quite out of the way, and prevents paper, &c. catching upon it.

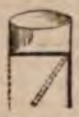
A Shows Beetson's Closet in section, with the valve closed.
B Shows how far the improved valve opens when the handle is raised.
C Shows the common (or Bramah's) valve open.

B



The improved valve.

C



Bramah's valve.

The dotted line shows the valve partly open, which is its position when the handle is raised quite up.

The valve of the improved closet cannot be opened, as shown by the dotted line of figure C, as the slightest movement of the handle opens it perpendicular, *or as far as the common closet, when its handle is pulled quite up.*

Another improvement consists of a valve being placed in the waste arm, (or overflow pipe); the use of this valve is to prevent smell from arising, should the part trapped be dried up, which is often the case.

I am,
Yours obediently,
F. Roe.

70, *Strand.*

MR. S. SEAWARD'S MEMOIR ON AUXILIARY STEAM POWER.

Sir—In your review of Mr. Seaward's memoir on Auxiliary Steam Power, you quote as from the 5th Part of Vol. III. of the Transactions of the Institution of Civil Engineers, the following passage, "the employment of a quadruple amount of steam power would not double the speed, although in theory this is assumed to be the fact." I have read the article over very carefully, and cannot find such a passage; the only one resembling it is at page 386. "The immediate consequence of this disproportionate increase of weight is a greater immersed section of the vessel, and a necessary increase of resistance offered to her motion, so that the force required to propel her through the water must always increase with the power employed, and not even cubing the steam power would produce double the velocity." It would be only just to make this correction in your next number.

M. Inst. C. E.

[The only answer we have to give to the above communication is to request any of our readers who may be desirous to examine for themselves, to call at our office and inspect the copy of the Transactions in our possession, and there they will find the passage as quoted by us, word for word; at the same time we are bound to say that we have seen another copy of the Society's Transactions, *since* the appearance of our review, and in that copy the paragraph is transmogrified into the one last quoted by our correspondent above.—Editor.]

ON ARCHITECTURAL CRITICISM.

Addressed to J. L.

An apology is certainly due from me to J. L., inasmuch as I addressed J. L. when Ditto, it seems, was the mystical person to whom, a reply being necessary, I should have replied. My hope of pardon from J. L. rests upon that gentleman's perceiving that the word Ditto, coming immediately after his initials, was the cause of my being led into the mistake alluded to. Upon the general manner of my writing, which J. L. condemns for want of simplicity, I feel compelled to be silent—readers being generally better able than writers are to determine such a question—though of course it cannot be supposed that I could, in reason, by bowing to the opinion of J. L., a nameless writer, confess to a fault by no means small. For although I would allow it to be very possible, that the revelation of my ideas upon criticism, may not have been sufficiently clear to every reader, yet I would submit to the intellectual critic, whether the necessity of fitting thoughts, often requiring a wide field for their display, into the columns of a periodical, would not account for occasional obscurity. It would be unreasonable for a person like myself, freely animadverting on others, to hope to escape animadversion himself, but if there are, amongst the intelligent correspondents of this Journal, any who have tried their skill on similar themes in a periodical, I feel certain of their indulgence. Leaving this matter to the discernment of just people, it only becomes me to notice the paragraph complained of, with the view of proving that the paragraph is not obscure and unmeaning, although J. L. may not perceive its force. I would remark that, unconcerned as J. L. was in the remark which led to that paragraph, and innocent as he was necessarily of the feeling, or affectation of the feeling, of contempt for me, which feeling, or its affectation, Ditto displayed in his remark, I was provoked to notice, he could not feel the edge of a reply which cut only as it *insinuated* what it was I despised. This manner of answering, if obscure, has been a favourite method of reply amongst orators and poets of every age, and for this simple reason, that it allows a speaker or writer to represent his own feelings, at the same time as he ridicules or expresses contempt for those of others.

April, 1842. Frederick East.

ON THE MEASUREMENT OF STONE BRIDGES.

Sir—In your last number a correspondent asks the best way of finding the contents of a stone bridge. No general formula can be found, but the following remarks—equally applicable to brick—will, I think, be found pretty general.

Begin by the piers, abutments, &c. It is best to keep the footings separate The following formulæ are useful for the contents of the arch :—

For a semicircle, $W. D. (R. \pi.)$

For a segment, $W. D. (R. \pi.) \dfrac{180}{\omega}$

where W=width of arch; D=the thickness (measured, of course, on a radius); R=internal radius + half the thickness: $\pi = 3{\cdot}1415$; ω=No. of degrees in arc. The backing and walls resting on arch have a curved outline. For this a straight line may be substituted, taking care to equalize the portions left out with those added; or they may be supposed to be carried down to the springing line, and from the contents thus found, the arch and archway (calculated as above) must be deducted. Many, and particularly railway bridges, are symmetrical about 2 axes; it is in this case the easiest way to take out the cubic contents in one quarter, and multiply by 4 for the total contents. Almost all bridges are symmetrical about 1 axis; in this case, of course the multiplier is 2. All the different parts should be kept separate, and their title put on the side, as it facilitates revision; and besides, many parts being repeated, saves the trouble of repeating the calculations.

I am, Sir,
Yours, &c.
A. H. P.

April 11, 1842.

STEAM NAVIGATION.

THE WEST INDIA MAIL STEAM PACKET COMPANY.

It pains us much to be unable to say anything calculated to repress the growing conviction that this is a most perilous enterprise—not that there is anything inherent in the nature of the scheme to render it necessarily disastrous, but that the management is so supremely injudicious as would be fatal to any project, even the most promising. It is true, that this evil admits of a simple and obvious remedy, but the constitution of the human mind is such, that men prefer to attribute calamities to any cause except their own ignorance or indiscretion; and a fault once committed, is oftener defended than acknowledged. On this account, although the means of amelioration are attainable, our hopes of spontaneous amendment are but feeble; and certain it is, that the accomplishment of such a thorough reformation as the exigency of the case demands, requires much fortitude upon the part of the directors, as it involves the admission of past errors and the dismissal of every cherished prejudice and prepossession. It is right, however, that the opportunity of reformation should be afforded, and we are willing to render our best advice and assistance towards so happy a consummation. It would grieve us much, that any calamity should fall upon this most spirited and arduous enterprise. Such an event would operate most perniciously upon the whole interest embarked in steam navigation, and paralyze the spirit of commercial adventure in the same channel. Should no improvement have been carried into effect before next month, it is our intention to enter into a thorough analysis of the character and management of this enterprise; and we are only prevented from doing so at once by the apprehension that our expositions might occasion such inconveniences as the obduracy of wrong-headedness alone deserves.

We entreat the respectable directors of this undertaking to give their immediate attention to this subject. Let them look to the dangers of their present position—dangers from which neither magisterial pomp nor inexperienced precipitancy can possibly save them. Was it ever before heard of, that the utmost skill and experience should be deemed unessential to the success of an enterprise of extraordinary magnitude and difficulty, though found indispensable to the prosperity of more limited and less adventurous schemes? and can the directors confidently say, that in the whole compass of their immense establishment, there is a single man to be found experienced in the conduct of commercial steam navigation upon the large scale? Is such an enterprise as this to be expected to succeed in the hands of inexperienced persons, even although those persons may unite much general ability with much plausible pretension? What are the fruits of such administration? There is scarcely a newspaper which does not teem with accounts of mails late—vessels wrecked, or missing—quarrels abroad—passengers almost starved—and vessels following one another *by mistake*—and at an interval of a few hours across the Atlantic? whilst, at other times, the greatest inconvenience and distress are occasioned by merchants being left without their remittances for months together, and correspondents without their letters. Do the directors imagine that such things will be long endured, or is it to their interest or credit that such things should exist? But all this is as nothing when compared with the loss which must arise from the working of the vessels under existing conditions. One vessel comes in with twelve or fourteen passengers—another, with five or six, bringing an income of a few hundred pounds, perhaps, when the expense of a voyage must be several thousands. There is the mail money, 'tis true; but how far will the mail money go towards paying for coal, insurance, and wear and tear? But we are departing from our intimated intention. We think the enterprise beneficially accomplishable, but not under existing circumstances; and unless those circumstances are so changed as to give the undertaking a fair chance of success, we shall, in our next number, draw the attention of the proprietary and the public to the subject.

"THE PRECURSOR."

This is really an extraordinary steam vessel. We were prepared to expect a handsome and an efficient vessel, from Mr. Rabert Napier, but we could hardly have anticipated that a vessel built for the ordinary purposes of commercial transport, should have been capable of making her way from the Clyde to the Thames in so short a time as 70 hours. A rate of progress, by the unaided agency of steam, such as the performance of this voyage involves, is in the case of large sea-going vessels, not only unprecedented, but almost incredible, and demands the most unequivocal testimony for its authentication. Under the influence of this sentiment, we have examined the "Precursor's" log: we have also derived collateral information from unbiassed and authentic sources; and we have much confidence in the exactitude of the information we now purpose to lay before our readers.

The "Precursor" started from Roseneath, a place on the Clyde, immediately opposite to Greenock, on the 8th of April, at 35 minutes after 1, and arrived at Blackwall at 5 minutes after 1, on the 11th. The total time occupied between the clock light, a little below Greenock, and Blackwall, was including stoppages, &c. 71 hours; and if we make a deduction of one hour for the several stoppages, inclusive of 50 minutes, during which the vessel was going quite slow, waiting for the pilot, the actual time occupied between the clock and Blackwall will be only 70 hours. The distance between those two points we have heard severally estimated at 775 and 800 geographical miles. Our own measurements, upon a good chart, induce us to believe the latter estimate the more correct, and 800 divided by 70 is equal to 11½ geographical miles per hour nearly. This is an extremely high average, particularly as the voyage was accomplished without any aid from sails, and the progress of the vessel, during a considerable part of it, was retarded by a head-wind of such intensity as to have reduced the speed of the engines from 15 to 13 revolutions per minute. We are informed, that her speed, when unimpeded by an adverse wind, was 15 geographical miles per hour.

The "Precursor" is the first of a line of large steam vessels about to be established between Calcutta and Suez, in continuation of the Peninsular and Oriental Company's line of steam communication between Southampton and Alexandria. The engines are of the common side-lever construction, by Mr. Robert Napier, of Glasgow, who, we understand, contracted for the entire vessel. They are of the collective power of 500 horses: the burthen of the vessel is equal to 1751 tons, N. M.

We shall, next month, more fully describe the dimensions and construction of the engines and vessel.

Il Peloro.—This is a compact steam vessel, built by Mr. Pitcher for the Neapolitan Government, for conveying the mails. Her dimensions are 130 ft. in length between perpendiculars, 19 ft. 6½ in. moulded breadth, and 20 ft. 2½ in. extreme breadth; depth in engine room 11 ft. 2½ in.; burden 252 tons, B.M. She is fitted with a pair of 50 horse engines, by Messrs. Boulton, Watt, and Co.; cylinders 3 ft. 3½ in. diameter, and stroke 3½ ft.; paddle-wheels 15 ft. 6 in. diameter; length of boards 8 ft., and 16 in. wide. She performed, at an experimental trip on the Thames, on Thursday, 21st. ult., an average velocity of 10¼ miles, consuming a very small proportion of fuel. The indicator figures showed a vacuum of 12 to 13 lb., with a pressure of 3½ lb. of steam.

NEW CHURCHES, &c.

Stockport.—The opening of the New Unitarian Church, a unique and very elegant edifice, took place on 23rd. March last. The site is in St. Peter's Square. The body of the chapel is a parallelogram, externally 63 by 44 ft. with a projection at the south end about 30 ft. wide by 14 ft., in which is placed the principal entrance, and the staircases to the boys' and girls' schools, and to the organ gallery. At the northerly end there is also a projection about 24 ft. wide, by 6 ft., in which is placed the pulpit and the communion. The interior of the chapel will accommodate 400 persons: there are no galleries except for the organ and choir, in the recess at the south end. The exterior projection at the south end is flanked by double bold buttresses, having circular shafts at their external angles, with bases and capitals to the same, the whole being surmounted with triangular headed canopies, out of which proceed octagonal turrets, surmounted by pinnacles, ending in carved finials, about 50 feet above the level of the street, and having an enriched corbel table round the foot of each pinnacle. Betwixt the buttresses to the south front there is a splayed recess, surmounted with a pointed arched head, with hood mould thereto, terminating upon carved heads. In the lower part of this recess is placed the principal entrance to the chapel; it has splayed jambs, and a pointed arched head, surmounted by a moulded triangular headed canopy, terminating with a carved finial. Over the door are three lancet windows, united together by their hood moulds, which terminate upon foliaged bosses, the centre window being higher than the side ones, and the upper end of the canopy of the door stands out quite clear of the lower part of the centre window. The gable in the south front has a moulded canopy terminating with a carved finial on the apex. The ends of the chapel, extending beyond the projections to the same, are finished with a moulded coping, terminating in moulded canopies at their lower ends. The sides of the chapel are divided into six compartments, by broad flat buttresses, with one set off, and terminating at the upper ends with the overhanging parapet, which is supported by moulded stone corbels betwixt them, with cast iron moulded gutters thereon, and in each compartment is placed a lancet window. The upper base moulding is carried along the sides of the building, and in the space under it, betwixt the buttresses, are placed the windows to give light to the schools. The whole of the exterior of the building is faced with stone, hammer-dressed, except the ashlar dressings and moulded work, which is tooled; the stone for the former is from the Kerridge delphs; and for the latter, from the Yorkshire delphs; and it is worth while noticing the greatly improved effect which the narrow courses from the Kerridge delphs give to the building from the usually wider courses which are obtained from other delphs. The entire cost of the building, including the additional expense incurred by the peculiar nature of the foundations, will not exceed £3000. The chapel has been designed by, and built under the superintendence of Mr. Richard Tattersall, Architect, of Manchester.

Ireland.—A Roman Catholic Chapel at Dundalk was opened on the anniversary of the Apostle of Ireland. It is constructed of hewn granite stone, from the neighbouring quarries, and is of the pointed style, which prevailed during the latter part of the thirteenth century. It consists of a nave and side aisles, divided by two rows of clustered pillars, having moulded capitals: from which spring lofty pointed arches, supporting a clerestory pierced with windows, which give light to the body of the church. The nave, or centre division, projects both in the front and rear several feet beyond the ends of the side aisles, having two lofty bell-towers, octagonal in form, composed of five stages, or compartments, with enriched cornices, panels, and mouldings. The upper divisions of these towers are extremely light and ornamental, having panels of pierced tracery, and slender, graduated, angular buttresses, which rise very boldly above the perforated parapet of the roof, and are crowned with embrasured parapet, pinnacles, and finials. The principal entrance to the church is in the north front, having three spacious doorways of great beauty. The grand entrance is between the octagon turrets, and is deeply recessed; the imposts are ornamented by well relieved mouldings and small pillars; from the capitals rise rich mouldings and tracery, which surrounds and intersects the pointed arch with a very pleasing effect. On either side of this entrance are placed ornamental niches, having angular buttresses and canopies, intended for the reception of full length statues. Immediately above the great doorway rises a magnificent window, 17 ft. wide by 30 ft. in height, having moulded imposts boldly recessed. The arch is surmounted by a hood-moulding, sustained at the springing by sculptured heads. The open part has six divisions, subdivided by an ornamental transom, which separates the window into twelve lights. The head is filled with delicate and varied tracery of very beautiful design. In the centre of the pointed gable is an ornamental opening, moulded and surrounded by a dripstone, which is filled with louvres, for the purpose of admitting air to the roof. Above is a large enriched raking-cornice, supporting a parapet of open panelled work, from whose acutely-pointed apex rises an ornamental cross. The lateral doorways are recessed with drip-stones resting on corbels. The spandrils are filled with carved shields and cinquefoil tracery. The flanks of the building are sustained by an equal number of graduated buttresses of three stages, which rise above the embrasured parapet, and terminate in pinnacles and finials. Between the several divisions of these buttresses the wall is pierced with large openings, having pointed arches and hood-mouldings; each opening is divided by moulded stone mullions and a transom into six lights, and the heads filled with tracery work. The south end of the church is in a plainer style than the principal, or north front. The body projects here very boldly, and is to be the Sacristy: it is flanked by octagonal towers. The great window which lights the Sanctuary is 36 ft. high, by 15 wide, divided and subdivided into fifteen openings or lights: the head is filled with very rich ornamental ramifying tracery. The clerestory which rises above the roof of the side aisles, is equally divided in the sides by buttresses and lofty pinnacles: between each buttress is a pointed window, filled in with mullions and tracery of cut stone. The *dimensions* of the building taken over the walls are 178 ft. from north to south, by 78 ft. in breadth; the height to the upper pinnacles of the nave 75 ft.; the elevation of the front towers is upwards of 86 ft. The rear towers are not yet finished; but the finish is intended to correspond, in every respect, with that of the front. When the edifice is completed, it will, without doubt, rank among the best of our modern ecclesiastical structures, both for magnitude and beauty of design. We have often greatly admired buildings planned and superintended by our distinguished and excellent townsman. But, regard to truth, as well as justice to professional merit, requires us to state that, for so far, Dundalk chapel is decidedly the *chef-d'œuvre* of Thomas J. Duff, Esq.—*Newry Paper.*

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 31ST MARCH TO 28TH APRIL, 1842.

Six Months allowed for Enrolment.

Joseph Clisild Daniell, of Tiverton Mills, near Bath, for "*improvements in making and preparing food for cattle.*"—Sealed March 31.

Julius Seybel, of Golden-square, Middlesex, chemist, for "*improvements in the manufacture of sulphate of soda and chlorine.*"—March 31.

William Liversidge Trippett, of Charlton-upon-Medlock, Lancaster, agent, for "*improvements in looms for weaving by hand or by power.*"—March 31.

John Bevan, of Whitehead's-grove, Chelsea, gent., for "*an improved mode of expelling the air from certain cases or vessels used for the preservation of various articles of food.*"—April 6.

James Smith, of Deanstone Works, Kilmadock, Perth, cotton spinner, and James Buchanan, of the city of Glasgow, merchant, for "*improvements applicable to the preparing and spinning of cotton, wool, flax, hemp, and other fibrous substances.*"—April 6.

John Read, of Regent's Circus, mechanist, Henry Putland, of Hurst Green, Sussex, farmer, and Charles Woods, of Fore-street, Cripplegate, commercial traveller, for "*improvements in the construction and make of driving reins, harness, bridles, and reins, and in bridles and reins for riding.*"—April 6.

Jean George Sire Clarke, of Euston-grove, engineer, for "*improvements in supplying and regulating air to the furnaces of locomotive engines.*" A communication.—April 6.

Thomas Clive, of Birmingham, iron-founder, for "*certain improvements in the construction of candlesticks.*"—April 7.

John Anthony Tielens, of Fenchurch-street, merchant, for "*improvements in machinery or apparatus for knitting.*" A communication.—April 7.

Marc Carlotti, of Little Argyle-street, Regent-street, Gent., for "*certain improvements in the construction and manufacture of boots, half-boots, shoes, clogs, and galoshes.*" A communication.—May 8.

William Falconer, of Clapham Common, Gent., for "*improvements in apparatus for attaching buttons and fasteners to gloves and parts of garments.*"—April 13.

John Byron Dawes, of Trafalgar-square, Charing-cross, Middlesex, Gent., for "*a certain improved chemical composition or compositions, to be employed in the preparation of glass or other media of light.*"—April 15.

John Lamb, or Kidderminster, machinist, for "*improvements in engines to be worked by steam, air, gas, or vapours, which improvements are also applicable to pumps for raising or forcing water, air, or other fluids.*"—April 15.

Thomas Richards, of Liverpool, bookbinder, for "*certain improvements in the art of bookbinding, and also in machinery or apparatus to be employed therein.*"—April 15.

Alfred Jeffery, of Lloyd's-street, Pentonville, Gent., for "*a new method of preparing masts, spars, and other wood, for ship-building and other purposes.*"—April 15.

Charles Farina, of Leicester-square, chemist, for "*a new method of manufacturing soap, candles, and sealing-wax.*"—April 15.

Kent Kingdon, of Exeter, cabinet-maker, for "*certain improv impressing and embossing patterns on silk, cotton, and other woven c fabrics.*—April 21.

William Noel, of Jermyn-street, St. James', boot and shoe-mak *certain improvements in the manufacture of boots and shoes.*"—Ap

Alphonse de Troisbrioux, of Great Russell-street, Bloomsbur for "*improvements in lithographic and other printing-presses.*" A nication.—April 21.

Otto Rotton, of Gracechurch-street, Doctor of Medicine, for *improvements in machinery or apparatus for spinning cotton, wool, other fibrous substances.* A communication.—April 26.

William Wood, of Wilton, manufacturer, for "*a new mode of carpetting and other figured fabrics.*—April 26.

Septimus Cocking, of Birmingham, draftsman, for "*certain ments in the production of light, by the burning of oil, tallow, and in the apparatus for regulating and extinguishing the same.*" Partl munication.—April 26.

Raoul Armand Joseph Jean Comte de la Chatre, of I square, Richard Tappin Claridge, of Weymouth-street, Ge Richard Hodgson, of Salisbury-street, Strand, Gent., for "*impr in preparing surfaces of fabrics, to be used in covering roofs, floors, c surfaces.*" A communication.—April 26.

Henry Robinson Palmer, of Great George-street, Westmins engineer, for "*an improvement or improvements in the construction and other parts of buildings; and also for the application of corruga or sheets of metal to certain purposes, for which such sheets or pl not heretofore been used.*—April 26.

Joseph Mege, of Keppel-street, Russell-square, merchant, for " *ments in the making or constructing of trousers.*" A communi April 26.

John Henry Pape, of Grosvenor-street, Bond-street, piano-fort for "*improvements in carriages, and in the construction of wheels.*—

John Varley, of Colne, Lancashire, and Edmonson Varle same place, cotton manufacturer, for "*certain improvements in steam* —April 28.

William Losh, of Newcastle-on-Tyne, Esq., for "*improvemen construction of wheels for carriages and locomotive engines intended ployed on railways.*—April 28.

The following Patents were accidentally omitted in the list of la

John Green, Jun., of Newtown, Worcester, farmer, for "*improv machinery or apparatus for cutting or reducing turnips, mangel wu rots, and other roots, for food for horned cattle, horses, and other* —March 7.

John George Bodmer, of Manchester, engineer, for "*improv machinery or apparatus for cleaning, carding, roving, and spinni and other fibrous substances.*"—March 7.

James Readman, of Islington, gent., for "*an improvement or ments in the barometer.*"—March 7.

John Duncan, of Great George-street, Westminster, gent., for " *ments in machinery for excavating soil.*" A communication.—Mar

John Warrick, of Lawrence Pountney Lane, Cannon-street, r for "*an apparatus called a gasoscope, and intended to show the pr bi-carburetted hydrogen gas (the gas used for lighting) in mines, wel buildings, rooms, and vaults; and consequently to prevent the explo accidents liable to be produced by the said gas.*"—March 7.

Francis Kane, of Cumberland-street, Middlesex Hospital, mec "*improvements in the construction of fastenings for the parts of and other frames.*"—March 7.

Sir Francis Desanges, of Upper Seymour-street, Portma Knight, and Anguish Honour Augustus Durant, of Long Castl shire, Esq., for *improvements in apparatus for sweeping and cleans nies or flues, and extinguishing fires therein, which they intend to moneur.'* "—March 7.

Robert Frampton, of Cleveland-street, Fitzroy-square, coach m "*improvements in the construction of hinges.*"—March 7.

TO CORRESPONDENTS.

O. T. *Both his communications have been received; one, or both, i will appear next month. We hope that, notwithstanding our delay in his papers, he will continue to forward us the result of his labours.*

Mr. Moxham's experiments on the strength and deflexion of wood and appear next month.

There are several papers which we have been obliged to postpone; li remarks upon Mr. Williams' boiler projects, and other subjects. We will to clear off all arrears in the next Johrnal.

Books for Review must be sent early in the month, communications on the 20th (if with drawings, earlier), and advertisements on or befor instant.

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TILDEN FOUNDATIONS

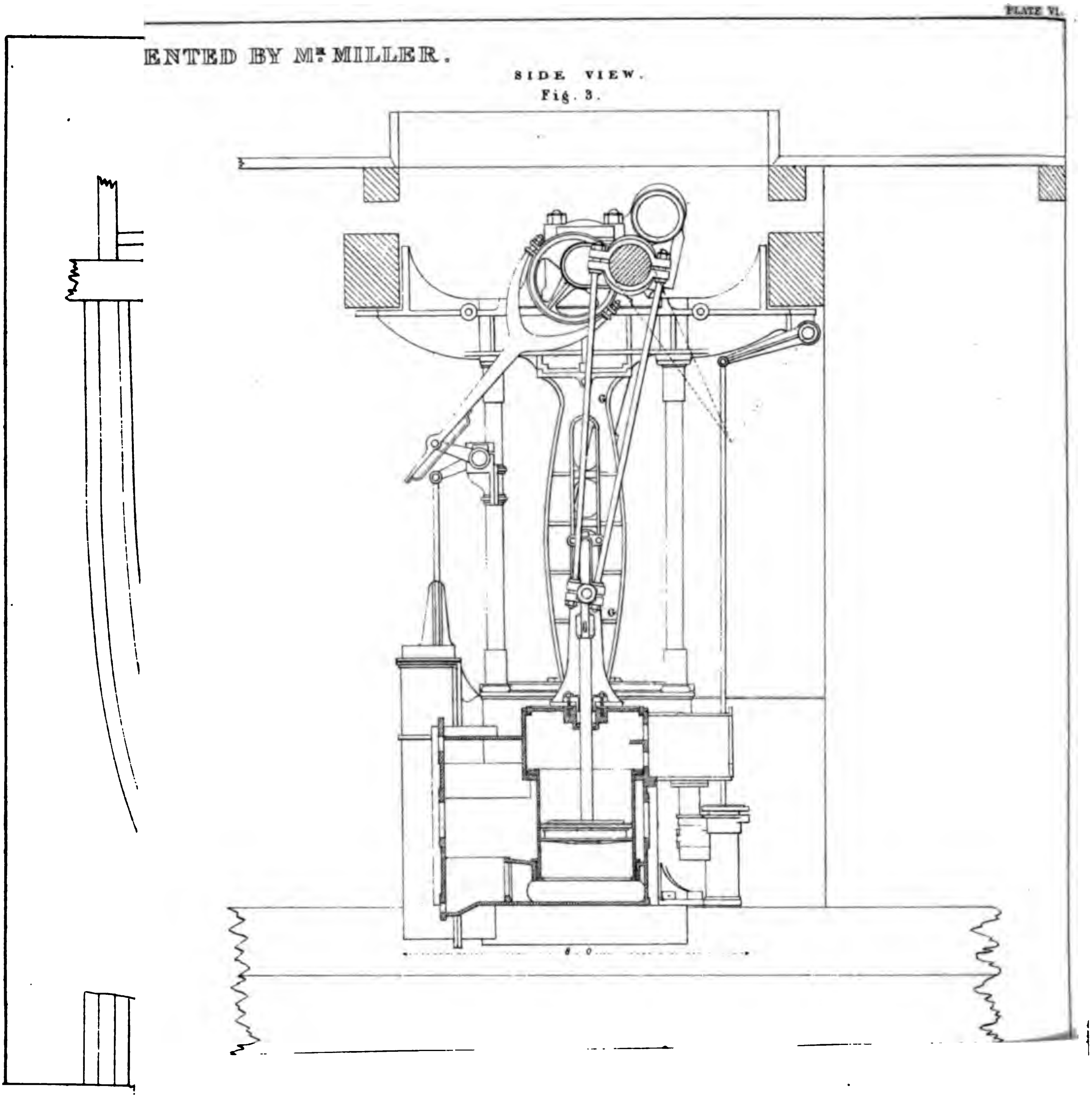
best test of excellence which all ca
machinery must be admitted to be the best which consumes to
he greatest quantity of work at the least expense. But the ad-
cation of this high authority is only to be obtained in the lapse of
—it is with difficulty to be obtained at all—and even then it is
y to be the resultant of a variety of circumstances of which the
ity of the machinery is only one. Nevertheless, any information

	at Plough tavern,			enlargement	
	Blackwall	1130	60	add 110	1180
14½	at Orchard house..	1350	60	add 80	1370

ENTED BY Mr. MILLER.

SIDE VIEW.

Fig. 3.



ments in the art of bookbinding, and also in machinery or apparatus to be employed therein."—April 15.

Alfred Jeffery, of Lloyd's-street, Pentonville, Gent., for "*a new method of preparing masts, spars, and other wood, for ship-building and other purposes.*"—April 15.

Charles Farina, of Leicester-square, chemist, for "*a new method of manufacturing soap, candles, and sealing-wax.*"—April 15.

ich we have been obliged to postpone; likewise ou remarks upon Mr. Williams' boiler projects, and other subjects. We will endeavou to clear off all arrears in the next Journal.

Books for Review must be sent early in the month, communications on or befo the 20th (if with drawings, earlier), and advertisements on or before the instant.

Vols. I, II, III, and IV, may be had, bound in cloth, price £1 each Volum

ENGINES BY MESSRS. MILLER, RAVENHILL & Co.

PATENTED BY JOSEPH MILLER.

(With an Engraving, Plate VI.)

ject of this arrangement of machinery is to economise room, object is certainly very completely attained; a power of of 300 horses occupying only 8 feet in the length of the ves- feet in the breadth. There are, it is true, certain counter- sadvantages—for example, the connecting rods, as well as tric rods, are short, occasioning not merely an increased the working of those parts, but disturbing the movement the slide valves, and there is the want of that equilibrium so nicely preserved by the side lever principle. These tach either wholly or partially to all engines of the direct scription; so that the gain in space and lightness is not a out any deduction. In these engines they are mitigated as possible by placing the cranks at such an angle as to preserve e as nearly as may be, and by such a configuration of the l under slide-valve faces as will neutralize the effect of the movement, consequent upon the shortness of the connecting tric rods.

ture of Messrs. Miller & Co.'s arrangement is rendered so y the accompanying drawing, that any detailed explanation ld be a mere waste of words. The connecting rods are to the tops of the piston rods, the latter being maintained pendicular position by means of guides G G, Fig. 3, in which ls work, one of which is shown at H, Fig. 1. There are two s, and the vessel in which condensation is accomplished, and s the whole space between the cylinders, is divided by a m so as to make it, in fact, two condensers, each with its own immersed in it, so that no sole plate is requisite; great s attained with a moderate weight of material, and a large compressible (so to speak) into a very narrow compass. The s are of brass, and the buckets are wrought by the cranks e intermediate shaft, and the tops of the air-pump rods are e upright position by the guides *g g*. M M are the man- rs of the condensers; B B are strong flanges or brackets, which the bolts pass for securing the engines to the vessel's

derstand Messrs. Miller and Ravenhill are now constructing these engines for the British government, the cylinders of 65 inches in diameter, and the length of the stroke 5 feet= ; also a pair for the French government, the cylinders of 68 inches in diameter, and the length of the stroke 5 ft. 6 in. .P. One pair of these engines is nearly completed.

neral character of Messrs. Miller & Co.'s machinery may, we be summed up in a few words. With a destitution of em- nt which, in some cases, we are disposed to regard as the too severe a philosophy, there is an excellence of materials manship, and a superiority of proportion and arrangement, ith an efficiency and an economy of performance which we lieve have ever been surpassed. In the minutest details of , as well as in its leading features, there are evidences of a acquaintance with the subject, both in its practical and phi- l relations. Where such anxiety exists to render the quality unexceptionable, and is united with so much ability and so perience, it is impossible that its quality should be any other e very first description; and it is therefore far from sur- hat Messrs. Miller's machinery should be esteemed so highly. test of excellence which all can understand is Time; for hinery must be admitted to be the best which continues to eatest quantity of work at the least expense. But the ad- n of this high authority is only to be obtained in the lapse of is with difficulty to be obtained at all—and even then it is be the resultant of a variety of circumstances of which the f the machinery is only one. Nevertheless, any information we may be able to gather respecting the actual performance of the machinery of any maker must, with all its liabilities to error, be admitted to be a valuable aid towards enabling us to arrive at a right conclusion respecting the probable qualities of any machinery of a similar kind he may propose to furnish.

RIVER THAMES EMBANKMENT.

Table of Distances on the Thames from Fulham Bridge to Blackwall, also the present width and the proposed contraction of the river as recommended by Mr. James Walker in his report to the City Corporation.

DISTANCES.	Present Width.	Contraction on the Middlesex or north side	Contraction on the Surrey or south side	Proposed Width.
	Feet.	Feet.	Feet.	Feet.
Miles below Fulham Bridge.	790	45	45	700
½ ditto	820	nil.	90	730
1	800	18	100	682
1½ at Sir George Wombwell's.. ..	800	16	54	730
2 at Battersea church	900	56	78	766
2½ at Battersea Bridge	745	36	13	696
3 at Old Swan, Chelsea..	930	72	115	743
3½ at Red House, Battersea, and Grosvenor canal	1000	250	20	730
4 near Johnson's dock	870	45	110	705
4½ at Vauxhall Bridge	900	64	36	800
4¾ opposite the Penitentiary..	600	nil.	enlargement add 33	633
5½ from the wall of the old houses of Parliament	1030			
now contracted by the new Parliament wall to	924	nil.	contraction 93	831
6 at Hungerford market..	1450	380	125	945
6½ at Somerset House	1243	138		
6¾ at Blackfriars Bridge	995	124	145	960
7¼ at Southwark Bridge	720	33	110	761
7½ at Old Swan.. ..	780	nil.	26	661
7¾ at the lower end of the Custom-house..	840	nil.	43 20	737 820
8 at the lower end of the Tower	900	20	10	870
8½ at East lane.. ..	1070	15		
9 at Rotherhithe church	870	nil.	55 nil.	1000 870
9½ at Bell wharf ..	970	18		
10 at Limehouse-bridge dock	770	nil.	nil. nil.	952 770
10½ and below the Limehouse entrance to the southernmost West India dock	1130	5	40	1085
11 at King's Arms, Limehouse reach..	1160	18	20	1122
11½ at Fergusson's masthouse	1110	60	18	1032
12 at lower side of Deptford creek	1160	15	70	1075
12½ at lower side of College wharf	1000	enlargement add 19	20	1001
13 at lower end of Enderby's rope-walk..	1260	contraction nil.	60	1200
13½ at Folly house ..	1170	36	50	1084
14 at Plough tavern, Blackwall	1130	60	enlargement add 110	1180
14½ at Orchard house..	1350	60	add 80	1370

EXPERIMENTS ON THE STRENGTH OF TIMBER AND IRON.

We have been favoured with the following interesting experiments on the strength of wood and iron, by Mr. Moxham, of Neath; they were made in the presence of a party of gentlemen for the purpose of illustrating the laws of increased strength, &c., in relation to increased dimensions; they are important for the purpose of testing the formulæ of Tredgold, and likewise the Tables given in the fourth volume of the *Journal*, pages 79 to 82.

American Yellow Pine Timber.

Experiments on bars of American yellow pine, straight-grained, dry, and free from knots.

Experiment 1.—Bar ¾ in. square, and 5 ft. between bearings, on which it rested loosely, the weight being suspended from the middle.

Suspended weight.	Deflection.
16 lb.	1·5 in.
24	2.25
32	3·00
34	3·31
36	3.81
38	4·44
40	4·75

In about 5 minutes this increased to 6·25 in., after which the piece broke with the same weight: the first symptoms of fracture were shown by cracks indicating a compression, from the top edge down to about the middle.

Exp. 2.—Yellow pine, as above, 5 ft. long, 1½ in. deep, and ¾ wide.

32 lb.	·375 in.
48	·33
64	·75
96	1·12
128	1·5
136	1·69
144 [increased to	2·
152 [ditto	2·25
160	2·62
[and incr. to	2·87
166	3·75

3¾ in. was the greatest *measured* deflection, and with this weight the bar broke, the first signs of giving way being near the top. When broken, the fracture was comparatively smooth at the top and about ⅔ of the way down, from compression; while about ⅓ at the bottom was ragged from the fibres being violently torn apart.

Exp. 3.—Yellow pine, as before, 5 ft. long, 2¼ in. deep, and ¾ wide.

128 lb.	0·5 in.
256	1·06
320 broke it.	

The depth which appeared to have been compressed and that which was extended were nearly the same as in the last experiment.

Exp. 4.—Yellow pine, 5 ft. long, triangular bar, the edge or vertex being down, 1½ in. wide on the base of the angle, and 1½ in. deep in the centre. ▽

16 lb.	0·19 in.
32	0·43
64	1·03
96	1·75
104	2·
112 broke it.	

Exp. 5.—Yellow pine, 5 ft. long, same section as last experiment, the edge or vertex of the angle placed upwards. △

16 lb.	0·31 in.
32	0.57
64	1·10
96	2·37
[increased to	2·62
100 & broke it	3·

Exp. 6.—Yellow pine, 5 ft. long, 1½ in. wide, and ¾ deep.

16 lb.	·75 in.
32	1·5
64	3·0
72	3·94
80	5·31
[and incr. to	6·0
82	7·25
[incr. to 7·81, & broke.	

Cast Iron.

The iron in this and the four following experiments was the same, being the best Welsh cold-blast iron, melted in an air furnace. Half the weight of the bar to be added to the weight suspended from the middle.

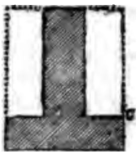
Exp. 7.—Cast iron bar, 5 ft. long between bearings, weight suspended from the middle, and ends loose as before; bar ¾ in. and $\frac{1}{32}$ square, or ·78 in.; weight of bar between bearings 9 lb.

112 lb.	1·375 in.
168	1·81
224	2·69
252	[3·22, & broke it.

Exp. 8.—Same length as above, and exact section ·40 in. wide and 1·55 in. deep; weight 9¾ lb.

112 lb.	0·125 in.
224	0·31
336	0·64
448	0·94
504	1·125
532	1·19
560	Broke it in

*half a minute. This was probably streng*thened by the fastening from which the weight was suspended being screwed tight, instead of left loose: it broke 2 in. from the middle.



Exp. 9.—5 ft. between bearings of this section, cast as it was placed in the experiment; weight 10 lb. A B = $\frac{11}{16}$, B C = $\frac{2}{16}$, B D = 1½, and F E = $\frac{6}{16}$ of an inch.

112 lb.	0·16 in.
224	·37
336	·69
448	·94
504	1·12
560	1·82
616	1·5
636 broke it.	

Exp. 10.—Bar cast from same pattern as above, but cast, and placed in the experiment with the thin part down, the reverse of experiment 9. This bar weighed ½ lb. lighter than the above, though there was no perceptible difference in the section, and it was equally sound.

112 lb.	0·42 in.
224	0.67
336	1·00
392	The bar bore this for a few seconds only.

Exp. 11.—Bar 5 ft. between bearings, $\frac{7}{16}$ (·437) in. thick, 2$\frac{1}{32}$ (2·03) in. deep in the middle, and ·91 at the bearings, the under side having the same curvature as a parabola, which makes the average depth 1·66 in.; weight of bar between bearings 11 lb.

112 lb.	0·16 in.
224	0·31
336	0·43
448	0·60
560	0·75
672	0·92
728	1·00
784	1·07 *
840	1·19 *
868 broke it. *	

* 3 in. from the middle on one side, and 16 in. from the middle on the opposite side; showing that there was more than a proportionate strength at the ends of the bar.

In Exp. 13 the bar was straight at top and hollowed out on the under side, having a section at the middle of 1½ in. deep, and $\frac{7}{16}$ in. thick, and at the ends of 2¼ in. and the same thickness. It was placed with the straight edge on the top, the ends being *loose*; and with a weight of 224 lb. + 5¼ (half weight of bar,) the deflection was 0·9 in. It was then taken up, and replaced with the curved edge up, the ends still loose; and with 224 lb. + 5¼ (half weight of bar,) the deflection was 0·94 in. It broke with less than 252 lb., but the quality of iron in this was not *quite* equal to that in the preceding experiments: making allowance for this, we should find its strength not greater, if so great, as that of a bar the same length and thickness, and of a uniform depth of 1½ in. The weight between bearings was 10½ lb.

Exp. 14.—Cast iron bar, a part of the one broken in experiment 7th, placed 2 ft. 6 in. between bearings; ends loose, &c., as before; weight of bar 4 lb. between bearings.

224 lb.	0·31 in.
336	0·47
448	0·62
504	0·72
560	0·86
588	0·98

Broke in putting on an additional 14 lb.

MISTAKES AND MISREPRESENTATIONS.

In speaking of our number for April, 1841, the *Bauzeitung* has fallen into a conglomeration of blunders, jumbling different articles and subjects together in the oddest manner possible. "Episodes of Plan on Roman Architecture," it says, "must be passed over by us on account of its length, and because it does not admit of compression; and for the same reason so must also Candidus *Notizen Buch!* Fasic. XXV, which paper consists of fragmentary criticisms, and chiefly upon Professor Hosking's lectures." This is a tolerably pretty specimen of the art of blundering by wholesale! "The Episodes of Plan" and "Roman Architecture" (the latter from the Penny Cyclopedia,) are two distinct articles, several pages apart from each other. As to the "Note-book," again, that Fasciculus is so very far from being chiefly upon Professor Hosking's lectures, that it only incidentally mentions his name in one of the shortest paragraphs, without saying anything of his lectures at all. But there does happen to be in the same number an article signed S. L., and headed "Candidus' remarks on the lectures of the Professor of Architecture," meaning not remarks by C. himself, but counter-remarks in reply to others he had previously made; nor were those remarks upon the lectures of Professor Hosking, but on the lectures of the Professor of Architecture at the Royal Academy. It will be a mercy if the *Bauzeitung* should not now go and mistake Professor Brown for Professor Cockerell, or jumble all the three Professors together, and compound them into one individual!

VELOCITY OF WATER THROUGH PIPES.

(From Report of Lecture by Dr. Melson in the Midland Counties Herald.)

The calculations for the head of water necessary to keep up a given velocity for every 100 ft. run of pipe, have been so ably deduced, from experiment, by Mr. Rofe, of the Birmingham Waterworks, that the lecturer could not forego the pleasure of pointing them out a little more in detail, and of giving the tables by which the necessary calculations were effected. The tables were two, and were both deduced from absolute experiment—not from experiments conducted by means of tin tubes of small diameter, fit only for laboratory uses, as there was too much reason to fear many of the tables previously published had been constructed, but from the absolute cast iron tubings themselves, as laid down in Birmingham and its vicinity. The tables were two: in the first, V represents the table of velocities in feet per minute, and T the constant numbers for those velocities:—

V	T
60	8·62
70	11·40
80	14·58
90	17·95
100	21·56
110	25·35
120	29·70
130	34·
140	38·90
150	44·
160	49·50
170	55·66
180	62·13

In the latter D represents the diameter of the pipes in inches, and *t* the constant numbers for those diameters:—

D	*t*
3	
4	·028
5	·053
6	·078
7	·104
8	·134

As an application of these tables, the following problem was proposed; it having been premised that the formula for their use was

$$\frac{T}{D \times t} = H$$

where H represents the height, or head of water. It is required, then, to determine what head of water will be necessary to send water by an engine through 1,500 ft. of six-inch pipes to an elevation of 80 ft. at a velocity of 180 ft. per minute. Now, by the table we see that the constant number for 180 ft. velocity is 62·13, and the constant number to be added to 6 inches is ·078,

$$\text{and } \frac{62·13}{6·078} = 10·22 \text{ inches.}$$

which is the head of water required to keep up the velocity of 180 ft. per minute for every 100 ft. run; which being multiplied by 15 (the number of hundred yards through which it has to pass), gives 153 in., or 12 ft. 9 in. This, added to 80 ft., will give 92 ft. 9 in. as the column of water which the pump must lift.

MEASUREMENT OF BRIDGES.

The formula given last month for the contents of a segmental arch was misprinted: it should have been

$$W\,D\,R\,\pi\frac{\omega}{180}$$

where W=width; D=thickness of arch; R=internal radius+½ D; π=3·14159; ω=number of degrees in arc. The following table will facilitate computation.

Table for Segmental Arches and Semi-ellipses.

c	R	ω °	ω ′	$\pi\frac{180}{\omega}$	$\frac{\pi}{2}\cdot\sqrt{\frac{a^2+b^2}{2}}$
2	1	180	0	3·14159	3·14
3	1·62	134	46	2· 344	3·99
4	2·50	106	14	1. 848	4·98
5	3·62	87	10	1· 516	5·96
6	5·00	73	44	1· 282	7·01
7	6·62	63	46	1· 139	7·80
8	8·50	56	8	· 976	8·87
9	10·62	50	8	· 883	10·46
10	13·00	45	14	· 787	11.09
11	15·62	41	14	· 717	12·19
12	18·50	37	50	· 658	13·31

The column headed c contains the ratios of the span of the arch to the rise, taken as unity; the corresponding numbers in R are the respective radii. In column ω are the degrees and minutes in the arc. The column $\pi\frac{180}{\omega}$ multiplied by W D R will give the cubic contents of the arch. The last column shows the length of semi-ellipses, of which the half-minor axes are unity, and the major axes the figures in column c. This multiplied by the width into the thickness, into the rise, will give the cubic contents of the arch in question.

The best formula for the cubic contents of a tube or cylindrical ring is $L\,\pi\,(R^2-r^2)$ where L=length; R=external radius; r=internal ditto; π=3·14159. Since the external radius=the internal+the thickness of tube, we have $L\,\pi\,(R^2-r^2)=L\,\pi\,(\,(r+d)^2-r^2)=L\,(2\,d\,r+d^2)$ where d=the thickness. Now, supposing that in an iron pipe d should=half an inch, d^2 will=$\frac{1}{576}$ of a foot. Neglecting this, as may be safely done for short lengths, the formula becomes

$$L\,\pi\,(2\,d\,r)$$

ANOTHER COMPETITION AFFAIR.

Sir—I am requested by Mr. East to lay before you the following statement of the disgraceful manner in which he, as a competitor in designs for the new church at Kidderminster, has been treated by the Committee, and their actuary Mr. Boycot. On the 10th of December last an advertisement, of which the following is a copy, appeared in the "Times" Newspaper:—

It is proposed to build a church in the parish of Kidderminster to contain 1250 sittings, of which 850 are to be free. Architects wishing to furnish plans for the same are requested to apply for farther particulars to William Boycot, jun. Esq., solicitor, honorary secretary; and all plans are required to be sent to him on or before Wednesday, the 22nd day of December next.

Kidderminster, Nov. 26, 1841.

You will observe it was published for the first time 14 days after date, thereby affording 12 days for the preparation of designs. As it happened we had at that time more leisure than usual, and made application to the said Mr. Boycot (who, by the way, loses no opportunity of advertising his calling,) for particulars of the advertisement, whereupon we received the following reply:—

Sir—The undermentioned are the particulars relating to the new church to be erected at Kidderminster.

I am, Sir, your obedien servant,
Kidderminster, Dec. 13, 1841. W. Boycot, jun., Sol., Hon. Sec.

1. That the church will be built, subject to the rules and conditions of the incorporated society.
2. That the expense must not exceed £3000.
3. That it be built of stone.
4. That there be a tower.
5. That the architecture be Gothic.
6. That there be a commodious vestry.
7. That there be no chancel.
8. That the pews be deal painted and grained oak colour.
9. That the whole of the galleries be free, and such other portions of the church as may be required to make up the number to 850 free sittings.

P.S. The above are the conditions the Committee resolved upon, but since then they have determined to receive plans of churches including a chancel."

Accordingly we set about making the drawings, but it subsequently occurred to us that something ought to be specified as to the terms of competition; whether or not the successful competitor was to superintend the work, or if any premium was to be received for the best design, and we immediately applied for information, in answer to which application the following letter was forwarded us:—

> Sir—In answer to yours of yesterday's date, I beg to state that no premium will be given for designs; and whether the successful competitor will be allowed to superintend or not I cannot say, but most likely he will.
>
> I am, Sir, (for Mr. Boycot)
> Your obedient servant, Geo. Boddington.

Now, had we not proceeded so far with the drawings as to render them useless for anything else, we should, of course, have declined having anything to do in a matter so strangely conducted; but we hoped they would improve upon acquaintance, and attributed this behaviour to want of good breeding as well as experience. Our designs were accordingly forwarded on the 21st of December, and not having received any communication, we wrote on the 1st of April to inquire whether the Committee had made selection of a design. Two days after this we received the drawings, unaccompanied by any note or acknowledgment, in a most shamefully mutilated state, and bearing evident marks of having been used on the ground. Three days afterwards the following letter came to hand:—

> Sir—Your plans were forwarded by coach on Saturday, the Committee having only decided on the 1st instant, and they desire me to thank you for having sent in designs.
>
> I am, Sir, your obedient servant,
> *Kidderminster, April* 5, 1842. W. Boycot, Jun.

As the description of our designs was not returned with the drawings, and not having then received the above letter, I wrote to Mr. Boycot as follows:

> Sir—I beg to acknowledge the receipt of our designs for the proposed church at Kidderminster, but the description thereof is not returned, and I shall feel obliged by your forwarding it at your earliest convenience. We feel somewhat surprised at the uncourteous treatment received at the hands of the Committee, no note having accompanied the drawings, stating whether they were approved of or not, and I think that after having detained them for nearly fifteen weeks, a letter of thanks is at the least due to the architect. I should feel obliged by your informing me who is the successful competitor.
>
> I am, Sir, your obedient servant,
> Wil. W. Wardell.

To this letter we received one in reply from Mr. Boycot, expressing surprise at the contents of the above, but not mentioning one word about the successful candidate. The matter then remained silent until Monday, the 11th of April, when, to our great astonishment, we perceived the following advertisement in the "Times":—

To Builders.—Builders desirous of contracting for the erection of the new church at Kidderminster may inspect the plans and specifications, by application to William Boycot, Esq., Solicitor, Kidderminster; and sealed tenders must, with the names of the sureties, be left at his office, addressed to the Committee for building the new church, on or before the 18th of April instant.

In the letter above quoted you will observe that the Committee only decided on the 1st of April. Now is it likely that in nine days an architect could prepare contract drawings, specifications, &c. ready for advertising for tenders? and not only so, but there was no architect's name mentioned in the advertisement. These circumstances aroused our suspicion that the whole affair was one of those disgraceful pieces of chicanery so frequently exposed in your valuable Journal, and determined us to pursue the inquiry of who was the successful competitor; and we accordingly wrote to inquire on the 14th of April, and on the 20th received the following reply:—

> Re Kidderminster New Church.
>
> Sir—I duly received your letter, but could not answer it till this day, the Committee having only decided yesterday. The successful architect is Mr. G. Alexander, of London.
>
> I remain Sir, your obedient servant,
> *Kidderminster, April* 20, 1842. W. Boycot, Jun.

Now what are we to understand? for this letter completely contradicts that received on the 6th of April. It was therein stated that the Committee decided on the 1st, and in the last letter he informs us it was on the 19th. Mr. Boycot will surely see the truth of the old adage, " * * * * " Probably when Mr. Boycot wrote to us on the 20th he had forgotten the contents of his letter of the 5th. We can hardly imagine that so respectable a member of the profession as Mr. Alexander could have lent himself to anything so unjust and contemptible, but it does appear to us that the advertisement for designs was a mere matter of conformity to the regulations of the Church Commissioners, and that it never was intended to be an open competition or an impartial selection.

I shall leave the matter in your hands, yet I trust, Sir, for the benefit of that profession whose cause you so ably advocate, you will not fail to expose this instance of the manner in which these robberies of professional time are carried on. We do not wish it to be understood that we consider our design had the least claim to preference, or possessed the slightest degree of merit, yet I must confess these extraordinary circumstances, together with the contradictory statements of Mr. Boycot, confirm the opinion that his conduct in the first instance suggested.

I am, Sir,
Your very obedient servant,
Wil. W. Wardell.

REGULATIONS ON RAILWAYS IN FRANCE.

The Minister of Public Works, in conformity with the opinion of the committee on steam-engines, has provisionally issued the following orders:—

1. The employment of locomotives on four wheels is forbidden with passengers' trains.

2. Neither tender nor any other carriage on four wheels to be placed at the head of the trains before the locomotives.

3. The locomotives to be placed at the head of the train, and never behind.

This regulation never to be violated, except in case of changing the direction of the trains at the stations, or in case of a train being stopped by accident, and that it should be necessary to send assistance from behind the train; but in such case the speed of the train not to exceed 22 kilometres the hour (13.7 miles).

It is moreover absolutely forbidden to enclose a train between two locomotives, one before and the other behind.

4. Until a better mode shall have been discovered to diminish the effect of shocks and collisions, there shall be placed one wagon without passengers at the head of each train composed of five carriages at most, and of two wagons, when the number of carriages in the train shall exceed five.

5. The passengers' carriages never to be locked.

6. Every railroad company to keep books, in which shall be entered the state and length of service of every axle-tree, whether straight or curved.

7. The Prefect will publish an ordinance, stating the interval at which two trains are to succeed each other.

8. The speed of the trains in their descent from Versailles to Paris on either line not to exceed 39 kilometres per hour. (24 miles.)

Independently of the above measures, the Minister of Public Works has requested the committee on steam engines to examine—

1. Whether in the descent from Versailles to Paris, and in fact in all rapid descents, it would be advisable to prohibit the use of more than one locomotive, and, if not, under what regulations they should be tolerated.

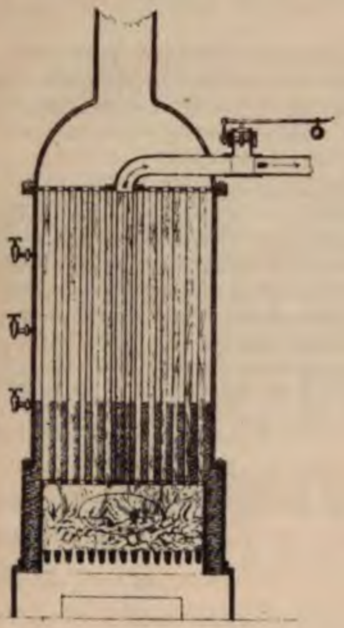
2. To discover the best mode of preventing inflammable matter from being communicated by the locomotives.

The Minister is moreover about to appoint a special commission to make experiments—

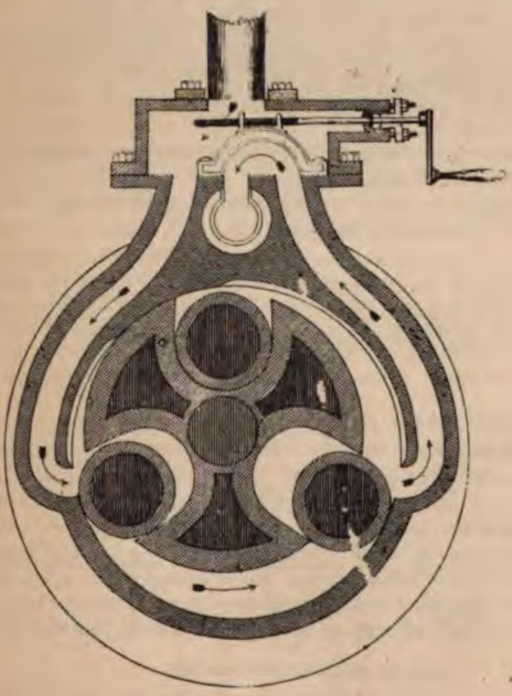
1. Upon the degree of perfection to which the axletrees of locomotives may be brought, and the length of time they ought to remain in use.

2. Upon the different means to be employed in order to diminish the effects and danger of collisions on railroads.

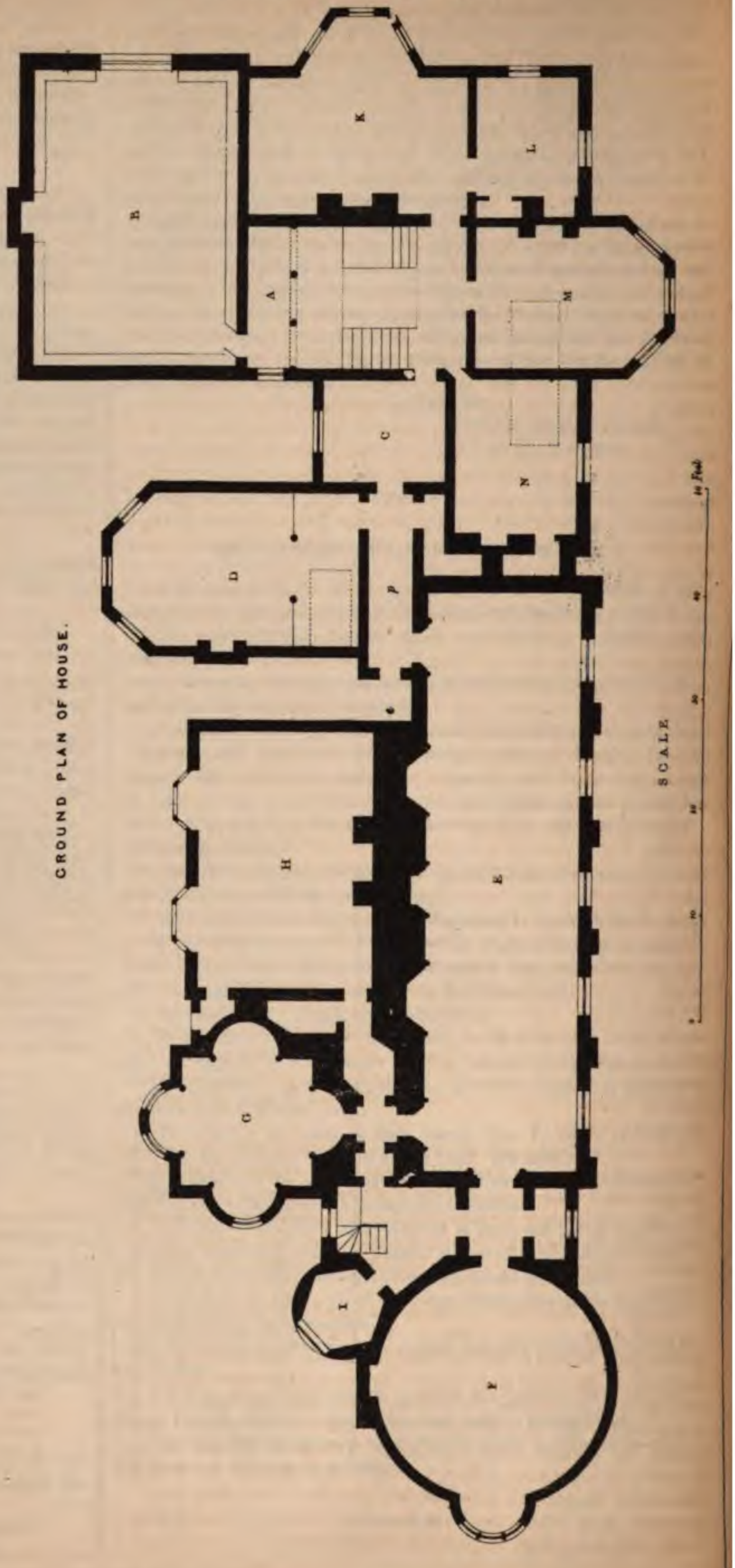
BEALE'S PATENT, 1842.



BEALE'S PATENT.



STRAWBERRY HILL.



GROUND PLAN OF HOUSE.

J. R. Jobbins 3, Warwick C

THE "ANTI JOHN SCOTT RUSSELL" STEAM BOAT.

(With an Engraving, Plate VII.)

In our last number we slightly alluded to the performance of this vessel, and then stated that we deferred giving the drawings of the engine and the boiler patented by Mr. Beale until we had an opportunity of making a second trial. Since then we have had another trial, when her performance was equally as good as in the first trip. The boat is a small iron vessel, 53 ft. long by 6 ft. beam, and 3 ft. 3 in. deep, and draws 17 in. at stern, and 13 in. fore, or 15 in. mean. The paddle-wheels are 6 ft. 5 in. diameter, out and out, with 10 float boards on each wheel, 2 ft. 9 in. by 7½ in. She is propelled by *one* rotary steam engine patented by Mr. Beale, and which is delineated in the annexed engraving Plate VII, Fig. 1, drawn to a scale of 1½ in. to a foot. The cylinder is 14 in. diameter, and 9½ in. long (measured transversely) in the clear of the casing. The drum is 12 in. diameter, having 3 indents for the reception of 3 rollers 4½ in. diameter, and 9½ in. long: these perform the office of the piston. At the top is the steam pipe: when the aperture is opened, as shown in the figure, the steam passes down the pipe, and acts against the back of the roller, and presses it forward until it reaches the aperture on the opposite side, where the steam is allowed to escape into the eduction pipe, and thence into the condenser, as indicated by the arrows. It will be observed that the apertures are always open, one for the reception of the steam, and the other for its exhaustion. The admission is regulated by a throttle valve in the steam pipe, before it enters the casing of the engine. The reversing of the engine is extremely simple: it is done by turning the screw, or by a lever which pushes forward the D slide valve, when it reverses the flow of the steam, which passes through the cylinder in the contrary direction of the arrows. The engine generally makes from 250 to 300 revolutions per minute, and by this rapid motion the centrifugal force causes the rollers to press against the outer casing, and allows the steam to act upon the back of them, as before explained. To the engine of the above boat there are 2 air pumps 8 in. diameter, and 11 in. stroke. The condenser forms a pedestal in the bottom of the boat, upon which the engine and pumps are placed.

The boiler, it will be perceived, is as compact as the engine. The drawing, Fig. 2 in the Plate, is drawn to a scale of ¾ of an inch to the foot. It is cylindrical, 2 ft. 6 in. diameter, and 7 ft. high over all, and contains numerous small tubes about one inch diameter, and an inch apart, through which the heat and smoke pass from the furnace to the chimney immediately over. The area of the grate is about 4 square feet, or half a foot per horse; the water occupies only a very small height of the boiler, the other portion forms a receptacle for the steam. We should think it would be better if the water was kept up to the second cock, otherwise great heating surface is lost. The steam is generally generated to a pressure of 40 to 50 lb. in the boiler. The consumption of coke is stated to be about 60 lb. per hour, depending upon the speed. The air for the supply of the furnace is driven in by the aid of a fan.

For communicating motion to the paddle-wheel there is a pinion wheel on the outside of the shaft or axis of the engine, which drives a larger wheel upon the shaft of the paddle-wheels, in the proportion of 1 to 4½, so that when the engine makes 270 revolutions per minute, the paddle-wheels make 60 revolutions. The total weight of the engine, condenser, air pumps, paddle-wheels, boiler, and water, is 2½ tons.

Having thus described the engine, we shall next proceed to give the particulars of her performance. The first trip we made was from Westminster Bridge to the Old Swan at Chelsea, when she performed the distance (2½ miles) in 20 minutes, against the tide when slack, and back again in 18 minutes, the tide being both ways just upon the turn at low-water. We then went down the river *with the tide*, and performed the distance from Westminster Bridge to London Bridge (2 miles) in 19 minutes; from London Bridge through the Pool to Greenwich Hospital (5 miles) in 39½ minutes. We then tried a measured mile (where the river was clear, from the 4½ to 5½ miles mark), which was done in 6 minutes with the tide.

At the second trial, she performed the distance from Westminster Bridge to Greenwich Hospital (7 miles) in 37 minutes, with the tide.

During the above trips the paddle-wheels varied from 45 to 58 revolutions per minute.

We will now analyse the power of the engine.

The radius of centre of pressure is apparently about 6·75 in., say diameter 13·5 in., and circumference = 42·39 in. by 225 turns per minute $= \frac{9537{\cdot}75}{12} = 794{\cdot}8$ feet, say 795 feet per minute.

Area of piston! or exposed part of roller appears to be 2 in. × 9½ = 19 in. area, although it is doubtful if the steam does not enter the space *behind* the roller, and exert its force on that part of the machine. Suppose we take it at 19 in. area, we have for power, at 7 lb. per inch nominal,

$$\frac{19 \times 795 \times 7}{33{,}000} \cdot = 3{\cdot}2 \text{ horses power.}$$

But this rule is not applicable, as the steam used is as high as 50 lb. or 40 lb., say mean 45 lb. in boiler, perhaps 40 lb. in cylinder or drum. With this pressure the vacuum is probably not more than 20 inches, if so much, but that is matter of experiment only, as it depends on circumstances not before us; suppose it be 20 inches, it will then be equal to 10 lb. We have, $\left.\begin{array}{l}\text{Steam pressure} = 40\text{ lb.}\\ \text{Vacuum}\quad\text{,,} = 10\text{ lb.}\end{array}\right\} = 50$ lb. effective

and $\frac{19 \times 795 \times 50}{33{,}000} = 23$ horses, which may be considered as ACTUAL power, and if this engine is expected to exert *double* its nominal power, as the common reciprocating marine engine does, we have $\frac{23}{2} = 11\frac{1}{2}$ horses power. Mr. Beale, however, calls it only 8 horse power; but this difference doubtless arises from our not having hit upon the proper pressure and vacuum, and which experiment only can determine, that is by a steam and vacuum gauge, for we apprehend the common indicator is inapplicable to this engine. The consumption of coke is stated to be about 60 lb. per hour, this for *nominal* power is equal to 5·2 lb. per horse per hour, and for actual power = 2·6 lb. per horse per hour, which is a very small consumption.

The paddle-wheel is 6 ft. 5 in. diameter, boards 7½ inches deep, inner diameter of wheel = 5·2 feet; taking the mean diameter at 50 turns per minute, the velocity will be 10⅓ miles per hour.

The amount of tear and wear is a question of practice, but the good workmanship which is now common, would obviate many difficulties formerly experienced. The engine is certainly very simple compared with previous patents of the same kind, and is also very powerful in working, and must be very economic in its construction, particularly when used as a non-condensing engine.

Besides the engine on board the "Anti John Scott Russell," Mr. Beale has one of a similar size and description at his manufactory at East Greenwich, worked at the low pressure of 4 to 6 lb.; it stands on the ground, and is hardly perceivable among the numerous machinery in the shop, although it drives the blast fan of a foundry, and sets in motion numerous lathes, planing machinery, drills, &c.

THE VARIATION OF THE COMPASS.

Observations made at the Royal Observatory, Greenwich,
G. B. Airy, Astronomer Royal.

Mean Magnetic.	Variation.	Dip at 9 A.M.	Dip at 3 P.M.
	° ′ ″	° ′	° ′
1841. June	23 16 16	69 12	69 1½
July	23 15 34	69 9	69 14
August	23 19 1	69 7	69 2
September..	23 24 17	68 43	68 38
October	23 12 18	68 43	68 35
November..	23 17 7	68 25	68 37
December..	23 11 5	58 22	68 27
1842. January	23 11 54	68 46	68 42
February	23 15 23	68 38	68 44

STRAWBERRY HILL.

(With an Engraving, Plate VII.)

After being forgotten, except as recalled to recollection by the reproachfully proverbial term of "Strawberry Hill Gothic," the residence of Horace Walpole has been the lion of the day for the two last months; and anecdotes of him, his writings, his correspondence, his collection—the last fallen into the hands of that eminent anti-collector, alias *disperser*, George Robins—have been retailed day after day. Such being the case, it may be imagined that there can now be very little indeed left for us to say upon the subject; but, strange as it is, it has actually happened that of the house itself and of the taste displayed in it, nothing whatever has been said, beyond a few meagre, vague, and fumbling remarks, and those chiefly borrowed ones.

The original house—which forms but a small portion of the present one—had nothing but its situation to recommend it, being little better than—indeed, hardly so good as—some modern "cottages," and containing only a few small and low rooms. To these Walpole first added two larger and loftier ones—the dining-room and library over it, on the north side—in 1753; and in 1760-1 extended the whole very considerably by the gallery and round tower, and tribune or cabinet, with the farther addition of the great or north bedchamber in 1770, six years after which he erected the small Beauclerk tower.

Horace may, therefore, be said to have "collected" his house as well as the curiosities and articles of *virtú* with which he stocked it; but though this piecemeal mode of building has been, perhaps, so far advantageous, that it may have prevented perfect uniformity of insipidity in the exterior, it has not prevented insipidity itself, nor has it produced any sort of character that can be termed picturesque. As to style, we meet with nothing at all better than either Batty-Langley-Gothic, or Guildhall-front Gothic—nothing whatever beyond the vulgar idea that mere pointed holes in a wall, and battlements on the top of it, are sufficient to constitute a Gothic edifice. We are ready to make allowance for the difficulties then attending any attempts in that style: at that period there were no publications in which it could be studied by means of accurately delineated forms and details; but if no such information was to be derived from books and engravings, most assuredly it was to be obtained from actual buildings, many of them at that time in a far more perfect state than at present, or even when drawings were first made of them. If he really possessed any feeling whatever for the art, it might be supposed that a man like Walpole must have derived some insight into the principles and genius of the pointed style, domestic as well as ecclesiastic, during his residence at Cambridge where he was the fellow-student of Gray—from whose taste he might have acquired something—and where he had constantly before his eyes examples which, if he had not sufficiently studied beforehand, he might at least have bethought himself of when he did set about building in a style not at all understood by professional men and their assistants.

Scott tells us that "the villa at Strawberry Hill gradually swelled into *a feudal castle*"! that Walpole "realized his own visions"; and that "in his model of a modern Gothic mansion, he had studiously endeavoured to fit to the purposes of modern convenience or luxury, the rich, varied, and complicated tracery and carving of the ancient cathedral"!! Perhaps, recollecting the architectural sinnings of the author of Abbotsford, Sir Walter thought that any reflections in a less indulgent tone upon those of the author of Otranto and Strawberry Hill, would come with a very bad grace from himself.[*] When, again, Sir Walter speaks very liberally and in pluralist phraseology of "turrets, towers, galleries, and corridors, with fretted roofs, carved panels and illuminated windows, &c.," "garnished with all the panoply of chivalry;" wherein he certainly indulges not a little in the privilege of a romance writer, and somewhat trespasses upon that of the *flourishing* George Robins. To talk of the galleries and corridors of Strawberry Hill inevitably calls to mind the old story of the boy and thousand cats—with this difference, indeed, that the boy at last admitted there really were *two* cats, whereas it is impossible to make out more than *one* gallery at Strawberry Hill, and nothing whatever deserving the name of corridor, as the plan of the building—and there is no arguing against such evidence—plainly shows. As to Gothic tracery and carving, there is scarcely any, and most certainly no tracery to be *traced* in the windows, which are externally no better than so many gaps, without even any sort of mouldings or other finishing. Now, whatever errors there might have been as to combination and general character, it might have been thought that a man whose taste was so essentially *microscopic* as was Horace Walpole's would, at any rate, have been tolerably exact as to minutiæ and detail. Yet, so far is this from being the case, that even those parts of the interior fittings-up which are said to be expressly in imitation of original models, retain very little of them except the mere general pattern, without aught of the original character; as it is, the bookcases are only "bird-cage" Gothic—most meagre and wiry. It is singular that one who could note all the most trifling details of workmanship, in minor articles of *virtú*—in carvings, enamels, ivories, bronzes, &c.—should be incapable of distinguishing the prodigious difference between his own *soi-disant* Gothicizings and the things they professed, however distantly, to imitate; or that if at all aware of such difference in what regards character and feeling, he should not at once have detected the cause of it, and adopted a more satisfactory system.

We do not, like many, make it a sneering reproach against Strawberry Hill, that it is little better than "a lath and plaster" fabric, patched together at different times. Neither of those circumstances at all affects the question now under consideration; for however light or even flimsy in regard to construction the house itself, it might have been made to display, as an architectural idea, many finished graces of design, well-selected and well-studied forms, well-understood profiles, careful and well-executed detail: there might, in short have been something like *gusto* manifested in the treatment of the subject, though the materials employed were ever so slight and homely. The employment of fictitious materials—of wood instead of stone—of ornaments and mouldings cast in composition or papier mâché, instead of being carved by hand, does not necessarily produce a trumperiness of appearance; on the contrary, whether the result be trumpery-looking or not depends less upon the worth of the materials and the mode in which the appearance aimed at is produced, than upon the taste which the architect or artist expresses in his ideas. Instead of beauty of design being destroyed by the ordinariness of the materials employed, it confers an æsthetic value upon these last which makes ample amends for their want of costliness; and if there is to be any disproportion at all between the worth of the one and the other, it is a lesser fault to have an artist-like design executed in "trumpery" materials, than a trumpery and tasteless design, however excellent the materials employed for it.[*]

Of both trumpery and bad taste, and of gross architectural solecisms—many of them downright vulgar in themselves, and almost inexplicable, as sanctioned by one who has the credit of having been a "minute antiquary"—Strawberry Hill affords so many instances, that wherever any sort of illusion is produced it is only for a moment, being dispelled at the next glance, or the next step. We grant that Walpole himself speaks very disparagingly of his own architectural doings, but it is with that sort of affected compliment-begging humility, which seeks nothing so much as to be contradicted; and though he is pleasant on the subject of his flimsy battlements, of which he says he had outlived three generations, he seems unconscious of the vulgar and cockney taste displayed in sticking up such paltry things at all. In point of taste, indeed, the exterior looks just such another sheepishly-fierce and frowning piece of "feudal castle" architecture as that box of battlements which has imposed upon no less learned an antiquary than John Britton himself, who—not having, perhaps, a prompter at his elbow at the moment—has pronounced it, in his publication on Edinburgh, to be—*beautiful!*

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[*] The house at Abbotsford is so contemptible as an architectural production, that all the *prestige* attending the associations connected with its name vanish on beholding it. Most persons have been wofully disappointed in their expectations of it—some have even expressed their regret that they have seen it at all.

[*] Of course this is to be taken *cum grano salis;* we must not be understood as holding it to be matter of perfect indifference whether a building be solidly constructed or not, provided it does but satisfy the eye, because, in proportion as it is beautiful, is the pleasure it affords increased by knowing that it is durable also, and calculated to last indefinitely. What we chiefly mean to say is, that where any sort of character is aimed at at all, the slightness of the materials, or their being fictitious ones, is no excuse at all for the design itself being incorrect, slovenly, and tasteless.

We will now proceed to examine the Strawberry Hill mansion more methodically and minutely. There is, indeed, one thing in its favour, namely, that neither externally nor internally does the entrance make any fallacious promise. So very far, indeed, is it from exciting expectations to be afterwards succeeded by disappointment, that it rather damps them altogether. You reach the entrance door through a little narrow alley, on one side of which are three paltry arches in the starvation-Gothic style, forming what is by courtesy termed a cloister, in which is—perhaps we should now say was—deposited a queer-looking piece of old crockery ware, which, you are told, was the identical china vase on which the "pensive Selina reclined," the feline female whose memory is embalmed in the stanzas of Gray. We almost wonder, therefore, that this cloister was not called the *Cat*-acomb, a title that might have been bestowed upon it with as much or more propriety than it is upon some of the passages and corners of the Soanean Museum. The mention of the last is, perhaps, somewhat unlucky, since it irresistibly leads us to remark that Soane and Walpole resembled each other in the architectural taste they displayed in their own houses, both of which seem as if put together from fragments picked up at different times at some curiosity shop, and whose several parts, even to mere passages and closets, are dignified with fine names. If in the Soanean one we have the Monk's Parlour, the Monk's Garden, the Shakspeare Recess, the Catacombs, &c., in the other we have the Refectory, Armoury (a landing of the staircase), the Shrine the Cloister, the Abbot's Garden, and so forth; an admirable system for even a blue band box might thus be converted into a Bluebeard' Blue Closet. Let us, however, boldly make our escape from th temptation to say more upon that head. Let us, if we possibly can restrain our pen, and compel it to be less frisky. Just now we talked of being methodical: alas for promises! There is more madness in our method, we fear it will be thought, than method in our madness.

As cloister there was to be, it would have been better to have planned it so as to be of some real service, which it would have been, had it been extended and continued (from *e* in the plan, which indicates the situation of the entrance-door to the house in the ground plan below,) as far as the entrance from the road, nearer than which a carriage cannot come up to the house; for in that case a comfortable sheltered approach would have been formed the whole way, one also that would have contributed—at least, might easily have been made to contribute—very materially to architectural effect as well as convenience. Or, putting both positive effect and convenience out of the question, the present skulking appearance of the entrance, which hides itself, as it were, in a corner, would have been got rid of. Having passed the threshold, we see little to announce architectural character and style of any sort, until advancing a few paces and turning to the left, we perceive the staircase, and there behold Gothic run mad, and ugly quatre-foil holes for windows, than which nothing can be more unlike anything to be met with in the pointed style, except perhaps here and there in some very rude and uncouth examples. Such things are no better than caricaturing the style pretended to be adopted: ugly in themselves, they have not even the humble merit of being passable copies—well-intentioned, but bunglingly executed. The same may be said of the rest, and the whole is no better than a mere patching together of incoherent bits of design, the only consistency observable being that all is nearly alike paltry, insignificant, and mean in taste; and how the possessor of Cellini's bell could tolerate such vapid architectural stuff—such mockery of Gothic art—is to ourselves incomprehensible. Passing up a flight higher than the first landing, or that level with the other rooms shown in the plan, we reach a broader one, extended by what is called the Armoury (A), but which may be said to form part of it, it being only a sort of lobby, divided from it merely by three open arches. Of the armour we speak not, but in regard to the Armoury itself, it does not call up visions of the days of feudalism and chivalry, but is likelier to put to flight any dreams about Otranto. The transition from warlike to literary stores is here sudden enough, for, taking leave of helmets and suits of mail, we find ourselves the next moment among books. The library (B) may be termed "a fayre and goodly chambre" as to size, yet ungoodly or bad enough in all reason as to the taste shown in its fittings-up. The design of the bookcases is said to be taken from that of the stalls of old St. Paul's, and sure enough, they do look as if the pattern of them had been taken from some ill-drawn old engravings, so meagre and wiry is it in all its lines, so hard and harsh in all its forms. The chimney-piece is borrowed from a tomb in Westminster Abbey; and the window is borrowed from nothing, but rather looks as if it were itself the original model or type of veritable cockney or carpenter's Gothic. Of such superfluities and encumbrances as mullions and tracery—which only serve to keep out daylight, and were, therefore, quite in character during the dark ages—it is perfectly innocent. Still it is in the pointed style, because it forms a great pointed opening in the wall. Besides this window, there are two little quatre-foil ones over the bookcases at that end of the room, which at first sight have very much the appearance of being holes or gaps made by cannon shot. The ceiling is flat, and being painted all over with heraldic devices and compartments, looks very much as if it were covered with a Turkey carpet nailed to it. Surely our English Horace might have learnt both from his Roman namesake and from his brother peer Chesterfield, that paltry inconsistency is inexcusable in such matters; for if it is worth while to do them at all, it is worth while to do them well. Yet Walpole seems to have had no or little idea of architecture, beyond that of bringing in bits here and there piecemeal, just as if it was not at all necessary to observe any sort of keeping in the design of a room, but doors, windows, chimney-pieces, &c., might look as if they had been picked up at auctions, and afterwards patched up against the walls in the best manner they could. To say the truth, the old-curiosity-shop taste seems to have taken such strong hold of Walpole, that it predominated even in his notions of architecture; and we even suspect that his friend Bentley must have sneered aside occasionally, when he found into what strange sort of architectural companionship his chimney-piece compositions from tombs and Holbein gateways were brought.

This library, together with the "Refectory" or dining room beneath it on the ground floor, and of the same dimensions, were among the first made by Walpole to the old house; but although two of the largest among what may be called the sitting-rooms, they are both so detached from the others on the same floor, that they cannot at any time be made part of the general suite thrown open for company. We must, therefore, descend again, and passing through the small anteroom, C, called the Star-Chamber, from the pattern on its walls, reach the Holbein chamber, D, so named from its chimney-piece, one of Bentley's compositions above alluded to. In other respects there is nothing particularly Holbeinish in this room, or that confers upon it distinct character of any kind. Lady Morgan, indeed, says of it that it looks like a pet-room of Catherine of Arragon; but to us it looked rather like one exceedingly petty in taste, in which no attempt has been made to keep up with tolerable consistency any one style. Dividing off the alcove in which the bed is placed, is a screen of three pointed arches, the centre one left open, the others filled with perforated foliage—the whole altogether different in design from the chimney-piece and every thing else; and withal of rather too gimcrack and toyish appearance in itself. As to the "royal-looking bed" which Lady Morgan was so fortunate as to behold here, that must have since disappeared, for the one we lately saw struck us as being particularly mean, small, and shabby. Among the "sights" in this room was the Cardinal's hat, a most interesting relic no doubt, and perhaps quite as authentic as some of the highly prized and carefully treasured-up rags of the Virgin Mary's gown; in short one of those [illegible] the gallery, [illegible] more [illegible] far [illegible] might [illegible] here we [illegible] to view [illegible] disappoint[illegible] room. Here [illegible] ing to fore- [illegible] be reached [illegible] that has a [illegible] some very [illegible]. We should [illegible] about here a [illegible] the adjoining [illegible] marked on the plan, [illegible] recess viewed through [illegible], and lighted above [illegible] or Claude-tinted [illegible] over the whole recess, [illegible], wherein many articles [illegible] displayed to very great [illegible] and paltry passage, considering [illegible] be rendered a very striking [illegible] the general architectural composition [illegible], because at all events there would be [illegible] light opposed to the dim obscurity of [illegible] architectural corridor, we should behold a [illegible] wards, and distinctly enough announcing [illegible] of more or less importance beyond it. [illegible] interfere with or [illegible] the larger gallery. On [illegible] enough of contrast, without [illegible] now rather disturbs our [illegible] dislocated, as it were, and [illegible] without any proper connecting [illegible]. Were our pen a magician's wand, [illegible] with it.

[illegible] we know not why, the Great Gallery, [illegible] being only 56 by 15 ft., and [illegible] surprise, and may be called spa- [illegible] with those parts of the house which precede it. [illegible] considerable improvement in Walpole's interior [illegible] ceiling, in imitation of that of the side- [illegible] chapel, and of which the mouldings are gilt, [illegible] richness to the whole apartment; but most [illegible] also, it is greatly marred by the five [illegible] opposite to the compartments and recesses on [illegible], while there are no corresponding ones on [illegible] might there have had window draperies [illegible] instead of that degree of symmetry being [illegible] between the opposite sides which is looked [illegible] in a gallery, it is here altogether [illegible] assuredly is not at all helped by the [illegible] windows, which, instead of forming em- [illegible] the wall a few inches deep, and conse- [illegible] with the recesses on the opposite wall. [illegible] we should take the liberty of transforming [illegible] bays, of the same size as the larger recesses, [illegible] the three middle ones. This would certainly be [illegible], and externally the throwing out such bays [illegible] for the worse, the outside of the building [illegible] bad, that making it worse is almost next [illegible] we would also conjure up a door, or rather the [illegible] end of the gallery; that is, a sham door with [illegible], so as to give an appearance of greater extent, and form a feature at that end of the room corresponding with the door at the other, but would have both in better design and taste than the present one. In fact, nearly all the present fittings-up require correction, and to be brought into harmony, for want of which there is now too much of the "scrap-book" character.

Lady Morgan speaks of the "Round Room which leads to the *sanctum sanctorum* of the edifice, the Tribune," but, as the plan very plainly shows, there is no such room between the Tribune (G) and the Gallery: and the Round Drawing-room (F) leads nowhere. This last is to us by far the most pleasing and unexceptionable room in the whole house: it has an air of simple elegance, comfort, and cheerfulness, with a quiet effect of light and shade. Yet even here there is one very sad fault—capable, however, of being easily corrected—namely, the pointed-arch door. Not only is such form inconvenient for room doors, but here more especially, because upon a curved surface: and so far from such acute form being required in order to accord with the rest of the design, it is positively at variance with it, the bay window not being arched at all, and the ceiling being *flat;* and as if with the intention of adding inconsistency to inconsistency, this door is painted *white*, with trumpery gilt mouldings. A *white door* is, as Goethe says, at the best a solecism in taste; but in Gothic, or any style of old English architecture, quite intolerable, and one would as soon think of painting a fine timber open roof of that colour. In consequence of its being so painted, the door here produces a glaring spot, and the ugliness of its design is rendered all the more conspicuous.

As we do not pretend to speak of the contents of any of the rooms, of the Tribune we shall say very little. It is far better in its plan and general form as to section, than in its details and the style of its fittings-up. As to the north or great Bedchamber (H), there is nothing in it that calls for architectural remark at all. One thing, however, to which we would call attention, as a happy point or accident in the plan, is the vista obtained from the same spot at the upper end of the gallery—northwards into the Tribune, and in the other direction into the Drawing-room and its bay. Thus that room, the Tribune, and the Gallery itself, form a charming and pleasingly diversified architectural group; one so fraught with scenic effect, that, however much there may be to condemn elsewhere, there here is something worth studying at Strawberry. Therefore, ere we cool upon this compliment, we will dismiss our pen at once—as, in fact, it is time to do; merely adding, by way of epilogue or moral, that there is a far greater curiosity than any in the whole collection, or than the whole collection itself, namely, the highly curious circumstance, that after being assembled by one W, it should be scattered by another W; and that it should have passed from the witty, *virtù*-loving Walpole to the witless and vulgar-minded Waldegrave.

REFERENCES TO PLAN.

A, Armoury.
B, Library, over Dining-room.
C, Star room.
D, Holbein chamber.
E, Gallery, over Great Cloister.
F, Round Drawing-room, 22 ft. diameter.
G, Tribune.
H, Great or north Bedchamber.
I, Beauclerk closet.
K, Breakfast room.
L, Blue closet.
M, Bedchamber.
N, Ditto.
e, Entrance, on the ground floor plan.
p, Passage.

ARTESIAN WELL IN LONDON.--The sinking of the Artesian well in Piccadilly has, we believe, been attended with the most perfect success, and there is now every probability of an inexhaustible supply of the purest water. After boring to a depth of 240 feet water was arrived at, which immediately rose to within 80 feet from the surface. Over the well a handsome iron pump is in progress of erection, and the inhabitants may now reckon upon a certain and plentiful supply of fine spring water. The expense of this useful work is estimated at 600*l.* Such has been the success of the undertaking, and so many the advantages, that it is said to be in contemplation to carry out the plan in St. George's parish, by causing Artesian wells to be sunk in different localities, best calculated to contribute to the convenience of the parishioners.

THE ANTIQUITIES OF NEW SPAIN.

Much has been said and written, from the age of Herodotus to the present time, on the magnificent edifices of the ancient Egyptians; there is an undying interest felt about that people and their works, an interest we all feel, and one that will endure for ages; but in giving so much of our attention to this subject, interesting as it undoubtedly is, may we not neglect others which, if not equally, may be well worthy our attention and research. Such a subject, we think, may be found for us in the architectural remains of the ancient inhabitants of the Spanish Mexican settlements; but in pursuing it, it is not our present purpose to enter into the question, what race of men were the real executors of these remains: such a question would lead us far beyond the limits of our article, and as such great names differ in opinion on the subject, it will appear like presumption in us to decide the point.

Of the early inhabitants of New Spain the Toltecans are the most ancient nation of whom we know anything; they came from the northward, being expelled from their own country (supposed to be Tollan) about the year 472. In rather more than 100 years after this they reached Mexico, where they settled; but some time after almost the whole nation was destroyed by famine and pestilence, occasioned by extreme drought, and the remnant of the Toltecans was incorporated with the Chichemicas, a succeeding nation under Zoloth, one of their princes. There is considerable uncertainty as to the origin of the present Mexican race; according to Bolunni they left their own country (Aztlan, supposed to be an Asiatic province) about the year 1160, but did not reach Mexico until nearly 60 years after; there they were first subject to, and afterwards conquerors of, the ancient Toltecan nation. For the sake of brevity, then, let us adopt the name of Toltecan for the architectural works we speak of, although the present natives attribute the erection of the buildings to "a race of giants," (a name given by many ancient nations to the Pelasgi), and proceed at once, as far as lies in our power, to the description of the works themselves, as it is plain that to whatever nation they owed their origin, they (the nation) must have had considerable general knowledge, especially of the mechanical, geometrical, and astronomical sciences.

The general form of the Toltecan religious edifices, and indeed the guiding principle in all their works, seems to have been the pyramidal, but unlike the pyramids of Egypt, they were not merely sepulchral monuments, but temples in themselves. Instead of their being graduated in regular courses, they formed stages or towers, each tower being a truncated pyramid, rising one above the other to the height of several stages, the upper surface of each tower (being flat) forming a base for and terrace surrounding the tower immediately above it. These buildings were square in plan, and the sides faced the cardinal points. The sanctuary was situated on the topmost tower, and it is a very singular coincidence that this kind of temple, the one at Cholula especially, answers almost exactly to the description given by Herodotus (Clio) of the temple of Jupiter Belus. He says "It is a square building. In the midst a tower rises, upon which, resting as a base, seven other towers are built in regular succession. The ascent is on the outside, which, winding from the ground, is continued to the highest tower. In the last tower is the holy place (*ναος*). As it is generally supposed, from various circumstances, that the Toltecan temples were dedicated to some solar divinity, the coincidence is the more remarkable, as the sun was worshipped under the name of Baal or Belus by the various nations of antiquity. The ascent to the place of sacrifice or sanctum sanctorum was by means of a broad and well finished flight of steps, usually situated on the western face of the temple. Sometimes this staircase, instead of ascending in a direct line, as in the flower temple of Xochicalco and others, traversed each tower in a diagonal or zig-zag course from the lower to the upper angle, as in the temple of Cholula before mentioned, and occasionally there were four flights, one on each face of the building; the temple of Tehuantepee may be quoted as an example of this last, but in it the principal staircase faced the west. It may be as well to mention that at Cholula, Dupaix discovered a very fine stone head, having on a kind of crown; from various circumstances he considered it to be either the capital of a column or part of a caryatic figure. The sides of their pyramids were sometimes ornamented with stone heads, but they were of quite a different description, more resembling the human skull. This was perhaps in allusion to their religious services, as it is well known they sacrificed human victims upon their altars. At Xochicalco (House of Flowers), the great temple has its sides adorned with immense flowers cut after erection; Nebel has restored this building in his work. To give some idea of the magnificent scale upon which the Toltecans executed their architectural works, it will be only necessary for us to give the dimensions of the great pyramid of Cholula. As nearly as can be ascertained (for the angles of it are much worn) its base is upwards of 1400 feet square, or rather more than twice the size of the pyramid of Gizeh, although in height (from the width of its terraces) it does not exceed 180 feet.

There has been much discussion among the moderns as to what style was adopted by the architects of Solomon's temple; some have supposed it to have been the Grecian Doric, others (ourselves among the number) have considered it the Egyptian, but Lord Kingsborough has brought a more novel theory into the field. He considers the Toltecan remains were executed by a portion of the Jewish nation settled in Mexico, and the Toltecan temple of Palenque to be modelled by them after that of Solomon. The general plan of this building is square; it is raised on a low truncated pyramid as a basement, and the ascent to the level of the floor is by a broad staircase situated on the eastern side of the temple. A kind of double gallery runs round and partly across the building, and divides it into three areas or open courts. The galleries, as well as the other chambers, have roofs rising high like the Gothic; the ceilings of the interior are similar, with the exception of their section being a truncated triangle. Out of one of the courts rises a square tower of very good proportion, diminishing gradually, of several stories in height, and having on the inside a staircase running up to the top. This tower was probably used by the Toltecans for an observatory, as we know they studied astronomy, not only from their manner of placing their temples, &c., but from there being some of their zodiacal carvings still extant.

At Mitlan are ruins of four buildings called "the Palaces," (Dupaix thinks they are sepulchral monuments and not the abode of their kings) the design of which seems to indicate the existence of a purer and more refined taste in their architect than is exhibited in most of the other Toltecan works. It is difficult to convey an idea of the plan of all these erections by description only, but we will take the principal one as the best suited to our purpose. Four buildings surround a square or court, three of them are rectangular parallelograms in plan, each containing one saloon; the fourth is similar to the other three, but has, in addition to the saloon, some chambers behind it, forming altogether a plan much resembling the Egyptian Tau. The greater part of the exterior is covered with elaborate and exceedingly beautiful designs in Mosaic, some of them vary much in the style of the Greek meander or fret ornament; the same mosaics are used on the architrave of the interior. In the saloon of the principal building are six granite columns without base or capital, supporting the ceiling beams; these are almost the only columnar examples we find, as the Toltecans generally made use of piers or substantial antæ in lieu of them. The walls were constructed of well tempered mud, lime and sand, the large stone facings being pressed into them to a certain depth while in a soft state, and the interior of the work was finished with a fine hard stucco bearing an excellent polish, and painted with ochre and vermilion. It is a circumstance worthy of notice that although chisels and other instruments of copper have been found among the Mexican ruins, no iron ones have ever been discovered. How then did the masons square their stones for building? (it is evident copper tools would not have been sufficiently hard for the purpose). Dupaix thinks they squared them by means of friction, and his opinion may receive some confirmation from the fact of their surface being exceedingly smooth. Under the saloon of the palace is a cruciform sepulchral chamber, entered by a flight of steps from the court above.

The ceiling of it is formed by beams of stone laid transversely; but at the intersection of the cross is a cylindrical column supporting a square slab of stone or abacus, forming the ceiling of the chamber at that part. The interior is richly ornamented with different kinds of mosaic fret, and is painted with vermilion. If we may judge from the ruins of their sepulchres which still exist, the Toltecan nation must have paid the greatest respect to the memory of their dead. Occasionally we find them deposited in caverns wrought by hand, similar to the one we have just spoken of; there is likewise one of the same cruciform shape at Chilan, and another, containing three chambers, near Xochicalco; but most commonly they constructed a large conical heap or tumulus, and faced it with stone or brick; through this was made an arched passage usually running north and south. A tumulus of this kind at Mount Alvan has one side of this passage lined with oblong slabs of granite carved with human figures. There is a very remarkable sepulchral monument situated likewise at Mount Alvan; it is constructed in a conical hill like those before mentioned, but there is also an arched passage running east and west, intersecting that running from north to south. At this intersection is a large and well constructed rotunda, the dome of which is somewhat in the shape of a parabolic conoid; the sides and interior are lined with good masonry, and at the top is a kind of funnel or chimney going right through to the exterior summit of the tumulus; this was probably used for purposes of ventilation.

The Toltecans generally made the arches of their bridges square headed, by means of a stone lintel laid across from pier to pier, but not unfrequently they placed long beams of stone leaning towards one another at an angle of about 55 degrees, and meeting at top, forming a kind of triangular straight-sided arch. In the province of Thascala are the ruins of two bridges of this latter description, and the angles of the roadway are ornamented with four piers or obelisks, of about 50 ft. in height, having an imposing effect. There still exists at Chilhuittan a bridge very peculiarly constructed by means of large blocks of stone, the upper surfaces of them being cut convex and the lower concave, springing from their piers and meeting together at the crown of the archway. The arch thus formed bears a great resemblance to our Gothic "Lancet."

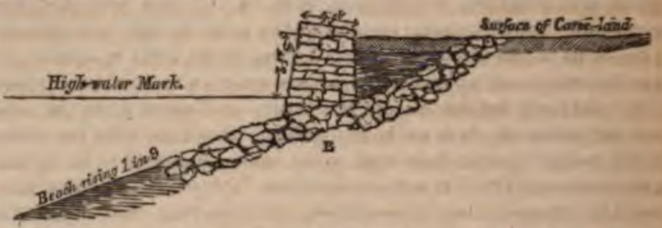
Perhaps it may be as well to say something of the roofs, doors, and windows of the edifices we have been describing. Of the first the interior frame was in most instances triangular, the angle at the apex being rather acute; but there are examples in the form of an inverted cyma, somewhat like the roofs of the Chinese buildings. Internally the sections of the ceilings were sometimes plain-sided triangles (occasionally truncated), at others they were graduated in overhanging courses, forming a kind of arch. The doorways were of a square or oblong form, having merely a plain stone lintel resting on its piers. Very many of the windows and niches are of the same description, but we find in them a much greater variety of form. They are some of them arched at top, some triangular, some in the shape of the Egyptian Tau, while others resemble the trefoil-headed Gothic arch.

Θ

PROTECTION OF LAND AGAINST THE SEA.

The expedient about to be described was put into practice at a part of the Moray Firth, near the town of Inverness, North Britain.

There was great reason for supposing that the Firth had encroached enormously at this place; and so certain and rapid seemed its progress towards the destruction of a portion of the carse land known by the name of the "Longman," lying between it and the rich town lands immediately contiguous to Inverness, that the inhabitants, foreseeing the certain destruction which awaited the town lands, and perhaps ultimately the town itself, if the carse land, which had by this time been reduced to an average breadth of about 100 yards, were not protected, determined upon erecting a very substantial wall, (A) as represented in the annexed sketch, and it was hoped that the evil would be thereby effectually cured; but after resisting the action of the water for some years by the aid of almost constant repairs, it was at length so much damaged that proposals and estimates were submitted for the purpose of erecting another wall of much stronger dimensions, and the inhabitants were preparing for another serious demand upon their purses, when they were agreeably surprized by receiving a proposal from Mr. William Hughes, then a contractor upon the Caledonian Canal, to protect the town lands effectually, and that at no cost whatever to the town, as he required no farther remuneration than the possession of the stones of which the wall had been formed. This agreement was eagerly entered into on both sides, and both parties were perfectly satisfied with the result.



The contractor's mode of operation was extremely simple, as may be seen by the sketch: the beach ascended from low to high watermark at an inclination of about 1 in 9, and then rose abruptly about 3 ft. to the level of the carse lands. Having removed the old wall, the contractor considered that nothing more was wanting than the formation of a beach of sufficient solidity to resist the action of the water, and having at the same time such a section as to allow the waves to exhaust themselves without meeting with any substance which might be injured by them. These objects were attained by removing sufficient stuff to admit of the beach being carried up and terminated by a gentle curve tangent to the original beach, whilst the surface of this newly-formed beach, and also down towards low watermark, was rendered solid by excavating a foot in depth, and depositing therein boulders found on the beach. This formation is represented by B in the sketch; and we have only further to add that nothing could have proved more creditable to the contractor, or more serviceable to those interested in its success, since, from the time of its completion till the present time, a period of not less than 26 years, the town has not lost one foot of land, nor been put to any expense for repairs.

H.

NOTES ON EARTH WORK, EXCAVATION, CUTTING, AND FORMING EMBANKMENT UPON RAILWAYS.

Article II.—Plant, Haulage, and Contingencies.

> "Modern practice has reduced it to a price per cubic yard."
> *Professor Vignoles' Lecture, Dec.* 1841.

The rails, wagons, sleepers, &c. used by contractors, are called the "Plant," and are of a lighter description than those used for permanent works. The rails range generally from 26½ to 30 lb. per yard, and the joint pedestals or chairs 20 lb., and intermediate chairs 12½ lb. each. The following were the prices paid in 1837:—rails 13*l.* per ton; chairs 9*l.* 10*s.* per ton; keys 24*s.* per cwt.; sleepers 1*s.* to 1*s.* 3*d.* each. The plant required for the conveyance of 213,000 cubic yards of earth with embankment consisted of 157 tons of rails, 67 tons of chairs, 28 cwt. of wedges and nails, and 42 wagons, estimated to contain or carry 1½ cubic yards each, costing 18*l.* 10*s.* each,* and 96 to contain 2½ cubic yards each, costing 23*l.* each. The cost

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* Wagons to contain 1½ cubic yards of earth, of which 42 were used—cost £777.

	£.	s.	d.
1 set of wrought iron work pedestals, bolts, and hoops, 390 lb. at 4*d.*	6	10	0
1 set of 24-in. wheels and axles	7	15	0
19 cubic ft. of elm, at 3*s.*	2	17	0
Labour of making each	1	8	0
	18	10	0

Wagons to contain 2½ cubic yards, of which 96 were used, each 23*l.*—cost £2208.

of repairs for each wagon was from 1*s.* 3*d.* to 1*s.* 6*d.* per week, no less than 97 out of 103 wagons requiring extensive repairs in one month. In addition to the repair, the lubrication or greasing of the wagon is a considerable item of expense. Supposing the plant sold after the completion of the work, it would perhaps produce—rails 8*l.* per ton; chairs in proportion; large wagons 13*l.*; small wagons 11*l.*; and sleepers 9*d.* each.

From all I can learn, and judging from my own experience, I calculate that the cost on each work for rails is about 1¼*d.* per cubic yard, and for wagons 1*d.*[†]

Before I proceed to consider the cost of haulage or horsing, I will give what Mr. Day says on the subject, in his Treatise on Railways, although not in his exact words:—"Taking resistance at 150th part of insistent weight for temporary roads, and horse power at 150 lb., to travel 12 miles loaded and 12 with empty carriages, at the rate of 2½ miles per hour, and allowing a fourth for weight of wagons, a horse will convey 64½ cubic yards one mile per day, which, at 7*s.* per day, including attendance, is equal to 1⅓*d.* per cubic yard; and that the effect of ascending a gradient of 35 ft. per mile will double the cost, 74 ft. treble, and 105 ft. quadruple it."—The cost is not in the ratio of the relative distance, as the haulage to and from the tip and gullet apply as well to short as to long distances. For the first mile I do not think that 2½*d.* per yard is too much for haulage, which is nearly double Mr. Day's estimate.[*] I consider that horse power is preferable to either fixed or locomotive engines, when the lead is under 2½ miles, but up to 4 miles a locomotive is to be preferred; and when the lead exceeds that distance, it will be cheaper to purchase land for side cutting, and run the surplus to spoil at the commencement of the cutting, or run the top lift into the adjoining fields. The average lead for most of the railways already made seldom exceeds one mile, which has been taken as the standard measure of cost, for which the price is generally about 1*s.* per cubic yard for the first mile, and 3*d.* per mile additional, or 1½*d.* per half mile, beyond the first mile.

The following are the prices at which many contracts have been executed on some of the great lines:—Midland Counties 12*d.* and 3*d.* per additional mile; Derby and Birmingham 12½*d.* all through average of lead; Great Western 12*d.* and 3*d.*, and for ballast 1*s.* 5½*d.*, and 6*d.* per additional mile, (on account of the difference in weight, say 19 cwt. to 28 cwt., between soil and wet gravel). On the Newcastle and North Shields Railway the price was 13*d.*, which I have divided as follows—excavations and repairs of wagons 8*d.*; rails and wagons 2*d.*; horsing 3*d.* From the above prices I think I may say that the price per cubic yard may be set at 12*d.*, which may be divided into the following items:—

Getting and filling	4½*d.*
Ganger's superintendence	¼
Repairs of temporary road	½
Tipping	¾
Plant, wagons, and rails	2¼
Horsing	2½
Contingencies and profit	1¼
	12

In addition to the price of 4½*d.* for getting and filling, 3*d.* extra must be added, if it should be necessary to resort to *gulleting* for the greater facility of execution. It frequently happens that the earth to form approaches to bridges is taken from the small severances of land in the immediate vicinity of the bridge, and the earth moved nearly vertically, by the employment of what are called "horse runs," the excavator, with his loaded barrow, being drawn up a slope of planks laid often at an angle of more than 45°. The price for getting the earth in this case is generally estimated at 1*d.* per man in the hole, only one man being employed as runner, the distance from the foot of the slope requiring more or less men, as the case may be. In the preceding observations I have considered the prices of earthwork, barrow work, run work, and wagon work. The parts I have not touched upon are horse work, meaning cartage, and tram work, and when tubs are used put or pushed by men—this information probably some of your correspondents, who may have the data, will supply.

When it is considered in what a hurried manner contracts are let, the contractor in the space of a few days having to satisfy himself of the nature of the strata and the correctness of the levels, also the quantity, which has perhaps occupied the engineer and his staff months to ascertain; also the arbitrary manner in which the conditions are framed, his materials liable to be taken from him, and his work entered upon by the company at the mere dictum of an engineer, it is surprising that men are to be found of energy sufficient to risk their capital for such a small chance of profit. And besides, such contingencies as wet and frosty weather, rise of wages and materials, and the risk of errors in calculation, both as regards clerical errors and errors in the principle, whether the prismoidal formula or average depth be employed in the calculation.[*]

Professor Vignoles, in his sixth lecture (*Journal*, p. 60), says that the correct method is by the prismoïdal formula, and that in a quantity of 332,000 cubic yards so calculated, and by average heights, there would be a difference of 22,000 cubic yards against the contractor, and if the mean area be used, there would be an excess of 44,000 cubic yards in favour of the contractor; hence, by the latter many contractors had realized, and by the former many had lost large amounts.

It is to the industry, energy, and boldness of the English contractor that enables him to carry on such extensive works as are undertaken in this country, and has thrown the Continental railways into his hands; and he has reason to be proud of the distinction. It is a practical illustration of the maxim that science is blind and without hands, and useless unless guided by experience. Many of the contracts on the English railways have been in the hands of men who could not write their own names.

I did not, when I commenced this paper, intend saying anything of the comparative cost of excavating materials of a more obdurate nature, but to confine myself to common earth; but from the interest I have taken in the

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[†] On account of the capital required for plant being so great, it is sometimes the custom for the companies to find rails and wagons, the permanent rails being allowed to be used for temporary purposes. The value of a plant for a contract 5½ miles in length, to convey 213,000 cubic yards, is nearly one-third of the amount of contract, taking 12*d.* per cubic yard as the price, viz. for—

Rails, chairs, keys, &c.	£3300
Sleepers	300
Wagons	2985
Total	6585

About seven miles of rails were used, besides two miles of wooden rails plated with iron for a back road, on which only the empty wagons passed. The facility afforded in tipping fully warranted this quantity of plant. The usual calculation for the quantity of rails required is the length of contract undertaken, if the works are to be carried on with vigour.

[*] Horses' keep calculated at the above:—

1 load of hay, 36 trusses of 56 lb. each, at 105*s.* to 110*s.* per load.

1 load of corn, beans, or oats, 5 qrs. and 8 bushels 1 qr. at 30*s.* per qr., and weighing 37 to 43 lb. per bushel net, allowing 3 lb. for the weight of the sack; beans, whole 2 cwt. 1 qr. 12 lb. per sack, split 1 cwt. 2 qr. 3 lb.; oats 1 cwt. 1 qr. per sack, at 24*s.* per qr.

Keep of horses at the above price, exclusive of driving.

per week each.		per day each.	
136½ lb. of hay 94 of oats 23 of beans	17*s.*	19¼ lb. of hay 13½ of oats 3¼ of beans	2*s.* 5*d.*

30 horses in 12 weeks consumed
740 bushels of oats,
180 ditto of beans,
181 trusses of hay.

42 horses in one week consumed

69 bushels of oats, 51 ditto of beans, 32 trusses of hay, 3 sacks of bran.	or,	94 bushels of oats, 48 ditto of beans, 26 trusses of hay, 5½ sacks of bran.

35 horses in one week consumed

70 bushels of oats, 42 ditto of beans, 24 trusses of hay.	or,	60 bushels of oats, or 70, 31 ditto of beans, 26 trusses of hay.

20 horses consumed in one week

35 bushels of oats, 21 ditto of beans, 2 sacks of bran.	or,	38 bushels of oats, 21 ditto of beans, 1 sack of bran.

The cost of harness is 2*s.* per week each.
Repairs of ditto and shoeing 6*d.*
Farriery and medicine 6*d.* per week each.
The value of the dung pays for the straw.

35 horses took	2250 cubic yards	67½ chairs	at	3½*d.*
55 ,,	2868 ,,	72	,,	4½
55 ,,	3600 ,,	82	,,	4½
55 ,,	2900 ,,	102	,,	4½

[*] There are also to be added the risk of an error in the fixing the value of the average lead, which I think is the most important point of all, requiring the exercise of the soundest judgment. And again, it seldom happens but what the rate of the gradient varies in the length of a contract, which will make a great difference, as before stated, a rise of 35 ft. per mile will double the price of haulage, and to have a small descent with the load is as greatly in favour of the contractor. There are besides the slips in cutting, and subsiding in embankment, and the upholding of tunnels, and other hazardous work; and as if all these contingencies were not enough, one of the principal engineers, lately in his report to the directors, urged the propriety of including in the contract for work *the value of the land* required for the railway.

subject, I am induced to add a few words. Perhaps by so doing I may elicit some further information from some correspondent, who may have the means of continuing the subject on rock excavation and blasting. In the first place I will give what Mr. Booth, of the Liverpool and Manchester Railway, says in his pamphlet on the progressive operations of that undertaking. The excavation was about 2,006,000 cubic yards: it was removed from a few furlongs to between three and four miles in length. The excavations at—

General price per cubic yard.

	s.	d.		s.	d.
Edge Hill; red sandstone	1	6			
Olive Mount; red marl and sandstone, two miles long .	1	0	to	2	0
Rainhill; clay, marl, and sandstone . . .	0	8	„	1	1
Kenyon; sand, gravel, and marl . . .	0	8	„	1	0
Eccles; marl and sandstone	0	10	„	1	4

It is unfortunate that the general price only is stated, which I suppose to mean an average lead, and not the standard of per mile.

On the Great Western Railway, near Keynsham, the cutting through limestone cost 10*d.*, 1*s.* 3*d.*, 2*s.* 5*d.*, and 2*s.* 6*d.*; but this again was general, the standard for comparison being wanting, or the horsing being mixed with the getting. On the Cromford and High Peak line, through limestone, the excavation cost 10*d.*, also an average of lead. If I may be allowed to hazard an opinion, I think the price of common rock would be for getting only 10*d.* to 1*s.* On the Glasgow and Paisley line, at Bishopton, the most expensive I ever heard of was through driffing whin or greenstone. It cost 6*s.* per yard; it was harder even than granite; and in the Bishopton excavation alone 621 tons of gunpowder was used. I have known tunnel work through gypsum and marl cost 2*s.* per yard for labour only, without risk of water.

Rates of tonnage per ton per mile:—
Stockton and Darlington Railway—Coals and cinders, 2¼d per ton.
Cromford and High Peak—coal and coke, 1½*d.* per ton.
Brandling Junction Railway—Slate and tiles, 4½*d.* per ton per mile.
Great North of England Railway—timber, 1½*d.* per ton per mile.
Hartlepool Railway—coals, 1¾*d.* per ton per mile.

St. Ann's, Newcastle-upon-Tyne. O. T.

ON FRESCO-PAINTING.

BY JOSEPH SEVERN, OF ROME.

(Continued from page 165.)

IN my former remarks (see *ante*, p. 161,) I attempted to explain why English artists would be more likely to excel in the grandeur of historical painting, through the medium of the fresco, rather than the oil material, and that the obstacles were not in our ignorance of that simple medium, but in our defective design, including our artificial and theatrical notions of composition. I hope now to be able to show, that in those essential points, design and composition, the English school possesses the real groundwork, which, with singular injustice to itself, it rarely or never exercises to its full extent, and which, if it did, there would be a hope of our surpassing all the continental schools of art; as I think the rare quality, which I am about to explain, is not to be found in so high a degree (if it is to be found at all) in any of them.

Judging the art of painting, as I do, by its great Italian examples, particularly in fresco, which is its province of freedom and power, I should say that there is a real and individual groundwork applicable and belonging to all the various powers of painting. This groundwork is Nature; not the perfect nature applicable to sculpture, often mistaken, and much abused in our time, as one and the same—but nature, with more of her imperfections than is generally supposed; imperfections that are essential to painting, if character and expression, or in a word if *life* be the object. No doubt sculpture, and the beautiful antique figures particularly, have somewhat blinded us as regards painting; and I cannot but think, that if it were the good fortune of modern times to turn up an antique picture of high Grecian art, even by Apelles or Zeuxis, we should find it entirely different to their sculpture in design and composition, as well as in everything else, for such is the case in the inferior examples at Pompeii and Herculaneum, wherein the principles I am anxious to explain are always found.

Sculpture exists in the perfection of form, whatever that form may be, and it must be selected from various examples; for it is rare indeed to find perfect form in one individual model, as adapted to sculpture; and this can be *easily understood* when it is considered, that sculpture presents nothing but abstract form to the eye. But painting, on the contrary, imitates nature in all her infinite variety; and in this universal imitation an obvious distinction is to be made, not only as to the means of the art, but the mode by which the painter attains his object. Historical painting, in including the diversities of complexions and customs of the people of different nations and ages, is obliged to include much that is ugly and unseemly, as well as much that is imperfect in form; for the painting art rests on its powers of representing character and expression with all the life and vigour it is capable of; and forms and things which would be vulgar, mean, and even incompatible with the abstract and limited power of sculpture, are obliged to be taken with all their imperfections by the painter, for they assist the pictorial and mental powers of his art. I am induced to dwell on this nice distinction, because, with reference to fresco-painting, I know that many persons suppose that the "good drawing," talked of as necessary, means the sculptural perfection of form I have been speaking of, and which, as applied to painting, carries with it the impression of insipidity and weakness, and seems to exclude the representation of vigorous character and living expression, which most of us feel to belong to painting. But sculpture, and sculptural perfection, as applied indiscriminately to painting, has helped to tame it down to a classic imbecility, if I may so call it, where the spirit of expression is driven to dwell in the extravagance and unnaturalness of academical and theatrical attitudes. When character and expression are not allowed to exist in form, then there is nothing left for them but attitude. This, I conceive, will explain at once the vast difference which is manifest between the quiet and natural manner in which the great Italian painters represented history, and that of the modern French, who have attempted to affect us in their historical painting by every species of action and extravagance, though always with the perfect forms and the drawing of sculpture. Their theory was to give perfection to painting, by imitating the perfection of antique sculpture; and they succeeded in introducing an original style, but from which we turn with displeasure, and sometimes disgust, to dwell on the repose and simplicity of the Italian masters, who, although accused of every kind of defect, we return to, and love even *for* their *defects*, because they are natural, and because painting assumes to be the universal language of nature. The French, in imitating the antique, have thought it expedient to give Apollo forms, more or less, to all their figures—to pare away every imperfection of humanity, whether it be in gods or heroes, or even in common men; and hence they have excluded character and expression, save in violence of attitude. This is the sad change which many English people falsely anticipate is to be brought about by fresco-painting; and this is the mistake which I am anxious to correct, in advocating the cause of fresco-painting.

Who will be so bold as to say, that perfect and select form is essential to painting, when, in the finest examples of Raffaello, Domenichino, and all the other great Italians, we find in every figure some example of the imperfections of nature *purposely* introduced—I say purposely, as there is no other rational way of accounting for the fact, but that they did it on principle. The antique figures were before their eyes, even more vividly than they are before ours: they were dug up in their time, and must have appeared more wonderful from their novelty; consequently, the Italian painters must have had the same temptation to take or leave them as we have, and they *did* take them, *but in part only*, and so far as they helped to develop the true and distinctive characters of painting. The French take them entire, and the English never take them at all. We can find, for example, in the figure of Heliodorus, by Raffaello, something of the grand form of the Ilissus (in the Elgin marbles), but we find nothing of the antique in the terrible scourging angels, who strike him down with such energy and life. Now, who can say that if the imperfection of forms which are found in those angels were taken away, it would not leave somewhat of tameness and insipidity? or why, if we are struck by the terrible fury which Raffaello has given these figures, should we not infer that it exists even in the ruggedness of their forms?

I can well remember the shame and surprise I felt on first going to draw in a foreign academy, at Rome—where every artist, even the beginners, produced such beautiful forms. But the fascination was soon dispelled; for week after week different models of different ages and characters were brought before us, from the young and gentle, to the strong and muscular, and these artists I found made them *all alike*. The different characters were so refined and idealized, that it seemed to me I was no longer in the province of Painting, but in the ideal world of Sculpture. Young as I was, I might blindly have concluded that these artists were in the right, had there not been all those immortal fresco works around me with which Rome abounds, and which convinced me of the modern error, and in the inspiration of which works I venture humbly to offer these explanations.

se works will show that the Italian masters selected individual nature
loubt the finest examples, but always individuals. How, indeed, is it
le to give that character which the art demands, without individual
, whereon to raise that structure of life and energy, that endless variety
ms and colours, those varied costumes with all their particularities?
, look to the landscape and architecture, with those effects of atmos-
which give such reality to the historic scene—how is it possible to
the figures belong to these (and to these they must belong), if the
are to be perfected with so much ideal beauty that they become the
nnatural things in the picture?

ating will have men nearly as they are; give them mind to any extent,
hem overflowings of life and soul—but they must look like men, for
t will have it so, as it had it in all the great Italian examples. Let
ors revel in their ideal world, but we must live in a real one if we wish
painters. This brings me to the immediate point of my subject,
it which these remarks would be impertinent—the groundwork of de-
xisting in the English school, but only the groundwork. This I con-
o be rather in the charm of nature as a characteristic, than in the
rtistical power of drawing academically well; for the one may exist
it the other, but in the design I am explaining they must exist together.
nd principle is in the natural, correct, and graceful building up of the

Reynolds is great in this, although he is thought to be so bad a
nan, while thousands of inferior artists succeed in the academical part;
nce and Italy, indeed, abound with them; in the latter country, even
n learn to draw according to the trick before they learn to read or

Reynolds aimed at something higher. It is true he gives us slovenly
-defined extremities, (the result, not of ignorance, but of his numerous
ments) but he *never* gives us a figure ill built up, or without the irre-
e charm of nature; and this I find, more or less, the characteristic of
glish school, in contrast to every other. It may have defects in the
of its drawing, it may have unsightly forms, it may have trivial and
subjects, its greatest excellence may be in portraits—in fact, it may
e most of the abuse which befalls it, but the charm of nature is never
g. Now this praise cannot be bestowed on any other modern school;
nall as it is, yet it is a genuine morsel, to be found in all the great
works from Raffaello down to Claude (who may be considered an
) in all of which you find the charm of nature. This is the real base-
of good design in painting; and although but a basement, yet it is one
on we can raise, if we please, any kind of structure in art; we can
use the antique—we can even deal in the grand forms of Michael An-
ith impunity, but always with this guide. It was this enabled the
English sculptor, Flaxman, (the greatest and most universal artist of
n times) to find out the essentials of Greek art, which the French have
issed. But in painting it was more difficult to be found. The Italians
it, and carried art to perfection, for in the imperfections they had the
e and taste to leave it; which imperfections the French, in trying to
way, removed also the key-stone of art—they left out the charm of
. In modern painting, perhaps, no one has gone so securely towards
rt as Reynolds, but he stopped short; and in carrying the thing further,
ceased to have this solid characteristic, and we have ceased to care
their works. Yet we care about Reynolds as much as ever, with all his
. Why is this?—he has the charm of nature. On the contrary,
nce, with fine qualities and a feeling for nature, sunk under the influence
hion; and we may trace to him the long throat, small head, and little
with much of the mawkishness of modern English art. Wilkie may
arded as the most perfect painter of the English school. He not only
ature, though not in all her charms, but he applied all the fine principles
; he concentrated them, and produced a style new, as it was a com-
on of several *never before combined;* he took Raffaello's power of
sing the subject, his elegance of composition and even design, with
randt's force and Tenier's mechanism, all bound together by the charm
ture.

s has to be done in English historical painting. The same principles
be extended and raised as we see them in the Italian schools. So far
e moral cowards in art, that in avoiding the errors of the French we are
t to be like little children, fed with spoon meat. In our painting we
leading strings, whilst we are full grown men in other things. This
arise principally from our strong feeling for nature when we attempt
ng; for we tremble at the brink of a classic influence, because we fancy
ot to be carried out with nature. The same with highly imaginative
—we fall short by becoming tame and mawkish; so that portrait, land-
and domestic scenes are the only things left to our wilful cowardice,
and these, as we do them well, we are determined shall be the only things we will do at all.

But now the historical field is opening to us in painting of the new Houses of Parliament, and we shall be forced into a bolder and more manly style of design. Let us not look at the French, or think that we are in danger of falling into their excesses, for we *are not*—it is *not in us*, if we wished for it; indeed, it is our *fear of it which keeps us back*. Let us, then, venture on the boldness of Italian art, that is, to do things without caring for the defects, but only thinking on the real and actual power *which lies in the sphere of painting, and of how little we have yet exercised it.* Our ancestors may not have been so handsome as the Greeks; but they were quite as manly, as full of genius, and have left us, *not works of art*, but enduring principles, institutions, laws, and a history of which we have now to *make* works of art. To this purpose Greek art would not be desirable, if we could have it. Englishmen transformed to Greeks would be as absurd as Greeks transformed to Englishmen. The Germans have succeeded in creating a style of design that is independent of the antique, though not nearer nature than the Italian, or with so much beauty. We, with our strong feeling for nature, may go still further, for we may use the antique as the Italians did, to make it our own; but it must be to gain something like power in design—something which shall shun the Gallic-Greek on the one hand, and, on the other, the influences of English fashion, both equally prejudicial to art. Surely here, as everywhere else, there are fine individual specimens of nature, if the artist will but take time to seek for them, for the English are considered to be a fine-looking people. In the great church processions of Rome, where there are many of all nations joined with the Italians, I always thought the Irish monks the most historic looking men. Yet, judging from modern exhibitions, one would think the English but an ordinary race, from the sovereign down to the artizans and beggars. Our women are considered to be the most beautiful in the world, whatever we may *paint and think them;* for in modern English art they are shown in every degree of languishment and lassitude, from the "Betrotheds" to the "Forsakens,"—all of which, I should say, were the productions of the most immoral people in the world, even more so than the French, who only disgust, did I not know they were meant to represent high-minded English women, virtuous as they are accomplished. All this arises from defective design, for as it cannot produce style, it produces fashion; and so a hideous monster, in the shape of taste, becomes the order of the day:—hence these ambiguous ladies, and gentlemen as their companions, with pocket-book faces. A very little honest drawing will remedy all this, but it must be drawing alone on a cartoon, for colour and effect will paralyze it. Let us have a touch of bold art once more, even as good as Reynolds, and we shall see fashion bow to it as it did to him.

ON THE FORCE OF THE WIND AND SEA.

Observed at the Delaware Breakwater in 1830 *and* 1831, *with some suggestions concerning the transverse sections of Breakwaters. By* Ellwood Morris, *Civil Engineer.*

(From the American Franklin Journal.)

That the force of the sea and wind often operates with tremendous energy against objects which resist their action, is a fact well known; to measure this force with precision is from the nature of things impossible, and hence it is only by a close attention to the observed effect produced by the waves of storms, upon opposing objects, that the engineer is enabled to form a proper idea of the energies of an agitated sea, when roused by gales to the assault of works raised for the protection of harbours.

To form a well sheltered harbour upon a site fairly exposed to the ocean, is one of the most difficult problems which can be proposed for solution by the engineer, for such is the difficulty of forming a stable barrier against the sea, that notwithstanding all that has been done in erecting sea-works under the direction of the ablest minds, we can at this day scarcely, if at all, point to an artificial harbour in a dangerous roadstead, which has realized the expectations of its projectors.

To appreciate, properly, the active forces which we are to countervail, is the first step in framing plans for sea-works; and to add another to the number of observed facts bearing upon this subject, is the object of the present article.

In the years 1830 and 1831, the writer (then assistant engineer at the Delaware Breakwater) had occasion to notice particularly, the severity of the action of storms upon such portions of that work as were then elevated above low water mark; the results of these observations we will now detail, merely premising first such brief account of the work itself as seems necessary to a full understanding of the subject.

The Delaware Breakwater was located and begun in 1829; it will, when finished,* consist of two detached dikes of rock, *the Breakwater proper*, a work of 1200 yards in extent, running in a line tangent to the seaward extremity of Cape Henlopen, and commencing at 500 yards distant therefrom; the *ice-breaker*, a work 500 yards long, lying obliquely across the prolongation of the line of the Breakwater, and distant from its western end 350 yards, at the nearest point; the Breakwater lies nearly in the original course of the ebb tide, trending E. S. E. and W. N. W., and will cover the harbour from the northern and eastern winds; whilst the ice-breaker (mainly designed to shelter the anchorage from ice drifting on the ebb,) bears E. by N. and W. by S., and will, at the same time, protect the interior from the winds of the north-west quarter; the contained angle between the horizontal projections of the two works being thirteen of the southern points of the compass, or 146¼°.

This artificial harbour is located in Cape Henlopen road, just within the pitch of the Cape, and its site is fully exposed to the sea winds which blow directly in from the Atlantic ocean, over the whole arc comprised between E. S. E. and N. E. by N. around by the East, measuring seven compass points, or 78¾°; whilst on the other hand, it is also exposed to winds sweeping an extent, for the most part, of deep water, upon lines of twenty miles long in the Delaware Bay, and including, in their field of action, the whole arc contained between the N. E. by N. and W. S. W., around by the West, being thirteen points, or 146¼°; from the W. S. W. around by the South to E. S. E., an arc of twelve points, or 135°; the roadstead is completely landlocked by the shoals of Broadkill, and the main strand in front of the town of Lewes, Sussex county, Delaware.

From the above statement it is evident that the roadstead under Cape Henlopen is wholly exposed to the winds of the north-east quarter, the severest that blow upon the American coast, and which fling upon the strand within the Cape those tremendous billows which are raised by the sweep of the north-east gales over a free range of ocean; whoever has witnessed the fury of these storms upon our seacoast, will, from these remarks, appreciate the violence of the seas which sweep that perilous road, wherein the writer has himself seen fourteen sail of vessels stranded at the same time, and with the loss of several valuable lives.

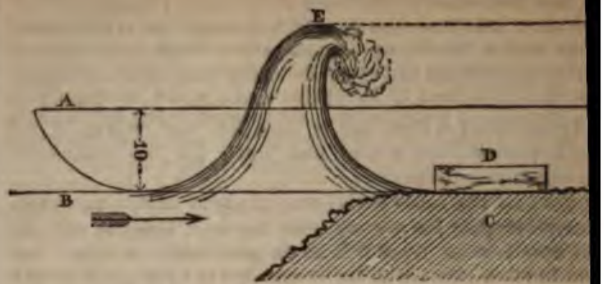
The average rise and fall of the tide in Cape Henlopen road is five feet, the highest spring tides, in moderate weather, seven feet, whilst the highest storm tides have been known to attain an altitude of ten feet and more above the plane of low water.

In the case of breakwaters, rising abruptly as they do from the bottom of the sea, it seems probable that the augmentation of altitude which waves receive in running upon an inclined coast, is not produced by them, or if at all, in but a slight degree.

The stones forming the summits of breakwaters, when assailed by the waves of the sea, are solicited by two forces, one acting vertically upward, with the force due to the hydrostatic pressure of a column of water, equal in altitude to the maximum wave which assails the work, and which force we can estimate; the other is the horizontal force due to the progressive motion of the billows, the extent of which we have no means of determining.

We may make a practical application of these views as follows; the heaviest stone used in the construction of the Delaware Breakwater, consisting of trap rock, from the Palisades on the Hudson river, weighed 184 lb. to the cubic foot; whilst the lightest, being the Hornblende rock, from Quarryville, in the northern part of the State of Delaware, weighed but 165 lb. to the cubic foot;† the average weight of the materials being 175 lb. per cubic foot, or $2\frac{7}{10}$ times heavier than sea water.

Fig. 1.



Let us assume, according to Arnott, the maximum altitude o to be twenty feet, then if we take the case of the Delaware water, where the storm tides rise ten feet, let *a*, in the annexed Fig. 1, be the top level of the storm tide, *b*, the plane of low the dry rubble foundation of the work thrown promiscuously fr sels into the water, *d*, a mass of stone lying upon the rubble fou with its base coincident with the plane of low water, and *e*, a 20 ft. high, advancing from sea at high water in the direction arrow, the crest rising 10 ft. above the high water plane, trough falling 10 ft. below it; then it is manifest that thoug the wave is upheaving near the margin of the work, it may very powerfully upon substances in front of its base, yet the it begins to subside, if it happens to be in the position indic the sketch, with its fore foot inserted under the mass of ston will exert upon that mass the upward hydrostatic pressure d head of 20 ft., and in an instant after the horizontal force due progressive motion of the wave; and thus, as it were, *by su pulsations*, the waves possess the power of advancing forward i masses of rock.

Now the upward hydrostatic pressure of a column of se 20 ft. high, would equal the gravity of a mass of stone w

175 lb. to the foot, if the vertical thickness of the latter were

or near 7½ ft.;* *consequently, if the depth or thickness of the stone were less than 7½ ft., it would be advanced a little to lee each successive wave; but if it were of greater vertical thickness stand fast, and resist the hydrostatic and progressive action of not surpassing* 20 *ft. in height.*

Breakwaters are, however, occasionally subject to augment lence, from the assault of waves during storms, *owing to the removal of atmospheric pressure;* a fact which has recentl observed by James Walker, Esq., F.R.S. &c., President of the Institution of Civil Engineers, and which was mentioned by a recent meeting of that Institute, (as reported in the Civil E and Architects' Journal for September 1841,) in the following w "At the Plymouth Breakwater, during the great storm in the of February 1838, several of the largest granite blocks, w from three to eight tons each, composing the surface or pave

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[*] If it be completed upon the plan projected by Com. Rodgers, Gen. Bernard, and W. Strickland, Esq., Commissioners, and approved by President J. Q. Adams, on the 27th of February, 1829.

[†] The Hornblende rock referred to, as weighing 165 lb. to the cubic foot, was the Greenstone from Jaque's quarry. A specimen of Gray Gneiss, from one of Leiper and Crosby's quarries, was found at the same time to weigh 168 lb. to the cubic foot; and some Black Gneiss from Hill's quarry, on Crum Creek, weighed 177 lb. per cubic foot. All the specimens of the above rocks, of which the specific gravity was tried by the writer, were broken off from masses of stone delivered at the Delaware Breakwater, in the construction of which all these varieties were then used. The specific gravities of some specimens of similar rocks, from the same quarries, were subsequently found, by a committee of the Franklin Institute, to be somewhat greater than is above stated.

[*] Corroborative of this calculation, we find it stated in Lyell's P of Geology, that "on the Isle of Stenness, in the winter of 1802, mass of stone, 8⅛ feet by 7 feet, by 5⅛ feet in depth, was dislodged bed (by the sea), and removed to a distance of from 80 to 90 feet."

This quotation shows clearly enough that a depth of *more than* 5⅛ *stone* is necessary to withstand the action of waves.

A similar circumstance is stated in the public prints to have occ a severe storm recently, upon the coast of Massachusetts, near th Island Lighthouse, where "a huge rock 23 feet long, 16 feet wide, a thick," which weighed probably 170 tons, was moved by the wave siderable distance *up an inclined surface;* evincing there *that a depth of six feet of solid stone* did not possess sufficient stability to r force of the sea.

How much more accurately than the moderns, the ancients app the powerful action of waves against sea works, may be inferred by lowing paragraph, quoted from Josephus, by Godwin, in the Tran Brit. Archts., 1835-6.

"In order to form a port between Dora and Joppa, Herod, in the year of his reign, ordered mighty stones to be cast into the se fathoms water, to prepare a foundation; the greater number of them in length, 9 feet deep, and 10 feet wide, and some were even lar these."

Stone of these prodigious dimensions would be very likely to their places in ordinary storms; and their magnitude is in striking to the comparatively small materials used in modern breakwaters, w a necessary consequence, *require incessant repairs.*

water, which, although squared and dovetailed into the and embedded in excellent cement to the extent of their)th, and thus forming a solid mass, were torn from their and projected over the breakwater into the Sound.

/alker attributed this to the hydrostatic pressure exerted ıe stones, at the moment when the atmospheric pressure been disturbed by the masses of water suddenly and rapidly pon the surface of the breakwater; blocks of stone were carried to a great distance, not so much by the waves lifting y the vacuum created above by the motion of the water, rted at the same time its full pressure from below."

additional evidence that the formation of a partial vacuum ıes a consequence of the envelopment of sea works by high . Walker further stated, "that during a storm in the year sea door of the Eddystone Light-house was forced outl its strong iron bolts and hinges broken by the atmospheric rom within. In this instance he conceived that the sweep t body of water in motion round the light-house had created nd momentary, though effectual vacuum, and thus enabled pheric pressure within the building to act upon the only art of the structure."

the above remarkable instances came professionally under of Mr. Walker, we are bound to place the utmost reliance nferences derivable from his statements; and they indicate ly that no lateral connexion by dovetails, or otherwise, will e for a want of depth of solid stone; but that we must ıbility in the coping of sea works, chiefly upon the weight mass of materials, *so connected as to gravitate as one body;*)ppose pressure by weight, and counteract by gravity the 'orces resulting from a disturbed equilibrium.

ssure of the atmosphere is about the same per superficial ould be produced by the gravity of 11½ ft. depth of stone, 175 lb. per cubic foot; therefore, if breakwaters were e assailed by waves but 20 ft. high,* at the same time that pheric pressure *was wholly removed*, their summits would ping with a depth of stone wrought into a solid mass, 1½+7½, or 19 ft. measured vertically.

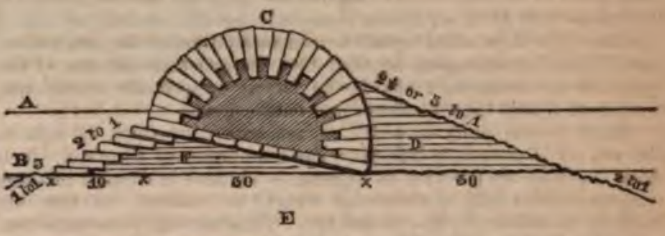
ature of things, however, we cannot suppose that *the whole* f the atmosphere would ever be removed from any point mit of a breakwater whilst a wave of the maximum height beneath; and though this is very much a matter of cone may probably infer that under no circumstances would two-thirds of the atmospheric pressure be removed from this would be countervailed by a depth of eight feet of ghing 175 lb. to the cubic foot, and as we have shown that near seven and a half feet is necessary to withstand the c pressure of a twenty-feet wave, we may finally infer that *ts of breakwaters should never consist of less than 15 ft. pth of stone firmly bound into a solid mass, by clamps, dowels, , so as to gravitate as one body.*†

The fact that continual repairs are rendered necessary, by the blowing up and sweeping away of portions of the pavements of existing breakwaters, during violent storms, strongly sustains the views taken in this paper, and shows but too clearly, that the mass of stone usually combined upon their summits, is deficient in the requisite stability.

The form in which the stone ought to be laid and connected together should (the writer believes,) be that of a semi-cylinder, the axis lengthwise of the work, and the base laid upon such an inclination seaward as may counteract sliding, and prevent the possibility of its overturning upon the harbour angle, for we know that on a level plane, one half the amount of force will overturn a body which is necessary to lift it.

In the case, then, of a breakwater similarly situated to that of the Delaware, stone weighing 175 lb. to the cubic foot, and exposed to the assault of waves not exceeding 20 ft. high, it would seem that the section shown in the following Figure 2 would be a proper one.

Fig. 2.



a, the high water line of spring tides, above which storm tides rise three feet or more; *b*, the plane of low water; *c*, semi-cylindrical mass of stone at least 32 ft. in diameter, thoroughly cemented and bonded together; *d*, fore shore securing the angle of the sea slope, to be mainly formed of cubical blocks of rough stone, weighing at least ten tons each; *e*, the general foundation raised to the low water plane by rubble stone thrown promiscuously into the water from the decks of vessels;* *f*, cemented foundation prepared for the semi-cylinder, and having a top slope seaward of about six feet base to one foot rise.

The advantage of a semi-cylindrical solid (which must average 15 ft. deep vertically,) is that if in the construction it is properly bonded on the diameter, with thorough courses of dressed stone, whilst the blocks which form the curved surface are cut like *arch stone*, no one stone could be by any means extracted from its place if properly doweled laterally, and the whole would resist motion *by its gravity as one solid mass;* the interior backing or hearting of the semi-cylinder would be composed of rubble stone well set in cement mortar, and grouted full in low courses, divided into sections for the purpose.

It is a general idea that the forces acting against a breakwater are augmented by a great rise and fall of the tide, but from the above reasoning it would appear that such a rise and fall as will allow a wave of the maximum height of 20 ft. to exert its greatest energy; or a difference of 10 ft. between the top water of storm tides and the low water plane, (as exists at the Delaware breakwater,) *will enable such waves to act with as much power upon sea works as any other variation of tidal surface*, and hence a greater rise and fall than 10 ft. will not increase, whilst a less one would certainly diminish, the effects of the assailing waves.

The section of the Delaware breakwater, as planned by the Commissioners appointed by the President of the United States, in 1829, under the act of Congress of May 24th, 1824, was trapezoidal in its general outline, the sea slope having a base of 105¾ ft. to a height of 39 ft., and being profiled after the curvilinear figure to which the waves of storms had reduced that of the breakwater at Cherbourg; the top was fixed at 22 ft.,† and the internal or harbour slope at one to one, or 39 ft. base, the entire base being 166¾ ft. to a height of 39 ft.; the base of the section which we have proposed as sufficient for a similar work, is 160 ft., and the transverse area would be nearly the same as that of the breakwater in the Bay of Delaware.

Philadelphia, Nov. 1st, 1841.

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aximum height attained by the waves of the most violent storms, of breakwaters, is such an important element in forming the plan , that it ought always to be ascertained experimentally, (which be difficult,) by attaching a machine upon the principle of a selftide gauge, to a pile well driven at the site, and properly braced sea.

rinciple of constructing sea works was adopted in Rudyerd's lightupon the Eddystone, in 1709, and which, after successfully withe storms of half a century, was destroyed by fire in 1759; re-Smeaton states that Rudyerd "judiciously laid hold of the great engineering," that "*weight is the most naturally and effectually weight,*" and accordingly formed his light-house, near its foun*d*, and mainly of stone, for such a height as he conceived would gravity of the mass to resist the upward hydrostatic pressure of in case the water insinuated itself beneath the building.

was not lost upon the able and sagacious Smeaton, who, in famous stone light-house which succeeded Rudyerd's, built the igh from the foundation, *solid*, and so proportioned the walls and ve the fundamental solid that if their mass were reduced to a shape it would add another solid column of about 20 ft. in that in opposing the action of the sea, the Eddystone Light-house t to a solid column of stone 50 ft. in altitude.

n the above reasoning, 50 × 2 $\frac{7}{10}$, or 135 ft., is the altitude of the e upward hydrostatic action this building is, by its gravity alone, o resist; and as the atmospheric pressure is never removed from whilst the utmost altitude of the jet of water which is sometimes r the lantern is short of 100 ft., its superabundant stability must

ses of this celebrated construction being dovetailed and joggled as to prevent movement laterally; as long as its materials are st decay, the immutable laws of gravitation will retain it in position, and enable it to defy, as it has for 82 years defied, the utmost force of the Atlantic storms; unless, indeed, it should be assaulted, by waves more than 135 ft. high, which is not within the range of probability.

* Experience at the Delaware breakwater proved that by this process alone a rough stone work could be brought up with precision to a plane of two feet under the high water of neap tides.

† With the design of increasing it to 30 ft., if subsequently found necessary.

MR. CHARLES WYE WILLIAMS AND HIS BOILER PROJECTS.

IN extirpating the heresies of hollow and obtrusive pretension, in our review of this gentleman's projects in the February number, we are generally conceived to have rendered an important service to the cause of practical science. It required little penetration to foresee that the performance of this service would subject us to much abuse and misrepresentation. An advertising patentee can hardly be expected to be thankful for any exposition of the fallacy of his projects; nor can the demonstration of the inefficacy of these schemes be supposed to be peculiarly acceptable to those compliant analysts who have ventured to speak most highly in their favour. We were willing, however, to encounter the opposition and obloquy of this party, from our sense of the necessity of resisting the growing practice of disguising empiricism in the garb of science. With this conviction we shall proceed to make a few observations upon the several rejoinders we have received to our former remarks;—not that we feel any sort of anxiety as to their effect upon our own reputation, or the conclusiveness of our former arguments, but that the articulate defence of the projects we condemned affords the fairest opportunity of exposing still more clearly their inefficacy and extravagance.

There is one point to which, at the outset, we think it right to advert, as it materially influences the complexion of the case. It is this: not only are the various arguments adduced in support of these projects intrinsically without any weight or moment, but they are actually inconsistent with one another. Thus Mr. Williams calls upon us to believe in the excellency of his boiler spikes, because their efficacy is "neither more nor less than the practical application of the well-known theory of conduction," whilst his more acute disciple A. S. calls upon us to put faith in the virtue of the spikes, upon the strength of something which he says is "sufficient to destroy all confidence in reasonings founded upon the ordinary hypothesis." So that, while one of these preceptors requires us to believe in the spikes because the received theory is certainly right, the other requires us to believe in them because the received theory is probably fallacious.

In our former article, when speaking of the spikes, we observed that they would speedily attain the temperature of that part of the flue where they were introduced. Mr. Williams has entered into a long and ponderous dissertation, for the purpose of showing that this is not strictly correct; a thing manifest enough if we be understood to have said that the small portion of the spike in the planes of the iron of the flue, or the portion thereto adjoining, is as hot as any part of the body of the spike upon which the hot air impinges: but this we neither meant nor said. Our statement may want precision, for it was not meant to be precise, but in the gross, and as applied to spikes of considerable length, it is substantially true; and this gentleman's objection to it is about as weighty as an objection to the statement of the distance between two continents in miles, instead of in feet, inches, and decimals of an inch.

The *modus operandi* of the spikes is thus explained by A. S.:—"We naturally expect that the lower extremities of the pins will attain a higher temperature than the exterior surface of the boiler, and we may conceive that that section of the pins which lies in the plane of the outer surface of the boiler may differ more or less in temperature from that of the outer surface itself; but the rapidity of the transmission of heat may proceed according to very different laws, and the greater difference of temperature between the extremities of the pins, combined with the greater facility afforded by increase of surface for the reception and giving out of heat, may occasion such an increased intensity of transmissive action as to cause a greatly increased flow of heat into the boiler." Mr. Williams, on the contrary, says "So far from these spikes attaining such high temperature, practice proves that so long as water is the recipient of the heat they convey, their temperature is in fact so low as to be touched without inconvenience, the heat passing through them as fast as it is received." Thus, whilst A. S. endeavours to persuade us that the spikes may be conceived to operate beneficially, by virtue of an increased transmissive action arising from the high temperature of their lower extremities, Mr. Williams assures us that the temperature of the spikes is not at all high—that they may be even touched without inconvenience—and that the heat passes through them as fast as it is received, so that no part of the spikes can ever be either hotter or colder than the water in the boiler. Yet these are the gentlemen to whom we are asked to pin our faith. With much of the dogmatism of infallibility, they are consistent in nothing but in being inconsistent.

In our former remarks we quoted a portion of a paper which appeared in the Mechanics' Magazine, and which purported to be a report of a lecture delivered by Mr. Williams, in which, speaking of he spikes, he said "The half-inch circular portion of the flue plates which such pin has displaced is thus made to possess the faculty of transmitting as much heat as is received and absorbed by nine half inches superficial;" by which we understood, we said, that the pin had the effect of transmitting to the water nine times as much heat as the half-inch disc it displaced. "This," Mr. Williams now tells us, "is a mere gratuitous understanding of a very plain position. I did not give any *measure* or *quantity* of heat so transmitted; I merely said as much heat *as is received and absorbed*." Did not give any measure or quantity! What, then, is intended by a reference to inches superficial but a reference to measure or quantity? But we will not higgle about trifles: we are willing to accept any amended meaning that Mr. Williams thinks fit to give us; and he now wishes, it would appear, to be understood as having only said that as much heat is transmitted as is received and absorbed. Be it so. The improved proposition, if it mean anything, only means that as much heat is transmitted as is transmitted;—a truism we should have been sorry to lay at Mr. Williams' door, except for his own requisition to that effect.

We stated, too, in our former remarks, that if spikes were capable, by virtue of their superior quantity of surface, of augmenting the evaporative rate of a boiler, a small flue surface spiked would be equal in evaporative efficacy to a larger flue surface unspiked; and a certain ratio would subsist between the power of the spikes in accomplishing evaporation, and that of the ordinary flue surface. We did not care, we said, whether this ratio were 9 to 1, as stated by Mr. Williams, or 1000 to 999; but that, if the spikes were of any use at all, in consequence of their extended surface, a certain number of spikes would be equivalent in evaporative efficacy to a certain area of flue surface, or a certain ratio would subsist between the efficacy of flue surface and spike surface. If this were so, we observed, by making the quantity of spike surface greater and greater, the quantity of flue surface might be made less and less, the evaporative rate of the boiler remaining the same; so that by increasing the quantity of spike surface sufficiently, the flue surface might be eliminated altogether, and we might actually have a boiler generating steam without any flue surface at all. We also observed, that if a spike three inches long were capable of transmitting more heat to the water than a spike of one-eighth of an inch long maintained at the same temperature, the received theory of conduction could not be right, because in that case rapidity of conduction could not vary as the temperatures simply, but as the temperatures and masses conjointly; so that it would be not the degree of temperature which would determine the rate of conduction, but the quantity of heat. According to this doctrine it was plain, we observed, that a very large body, though cold, would communicate as much heat as a very small body, though hot, provided the absolute quantities of heat resident in them were the same; so that a sufficient extent of spikes, though cold, might boil water and generate steam, without the aid of a fire.

To all this what does Mr. Williams answer? That the auditory of some Polytechnic Society could not see the absurdity imputed to his projects; that he does not measure the quantity of heat transmitted by the mere surface of the spikes; that spikes, though they are beneficially available up to a certain length, yet that length is not infinite, but the length of three inches is practically the best; that the number, too, of the spikes must not be increased beyond a certain limit, else the hot air will not obtain access to their surfaces; and that how the extravagancies imputed to his projects are deducible from the well-known theory of conduction it does not become him to say. Now did ever any one hear such a reply to such an argument? We show this gentleman that his doctrines lead to absurd conclusions, and he answers us by saying that how such absurdity is chargeable upon the received theory of conduction is incomprehensible to him. It is not with the received theory we find fault, but with *his* theory; nor do we find fault with its absurdity alone, but also with the arrogance with which it is advanced, and the equivocal character of the expedients by which it has been attempted to uphold it. The received theory of conduction is reasonable enough; the *reductio ad absurdum* has no power over *it:* but this gentleman's theory, turn it as you will, is irreducible to anything except superlative nonsense, and yet it is ushered forth with as much parade and ostentation as if it were the greatest discovery that had been made for ages. But the Polytechnic Society cannot see its absurdity. What have we to do with that? Is it because others happen to be blind that we are, therefore, to put our eyes out? We know that there are persons in the world who have no very clear conception of where it is the sublime terminates and the ridiculous begins; and it would be an anomaly in the history of delusion, if a consummately preposterous project were not to have some admirers. But as such persons are usually too incandescently wrong-headed to attend to the dictates of sober reason, their conversion is as hopeless as their authority is invalid; and it would be in every sense superfluous to address ourselves to them. With such we have no concern: nor is the Polytechnic Society anything more to us than Hecuba was to the Prince of Denmark.

But further; the mere surface area of the spike is not the measure of transmissive power. What then *is* the measure? or is there a measure at all? If amid all the riot and pretension we have witnessed, it should turn out that there is no measure of the beneficial effect of the spikes at all, is it possible to resist the conviction that the whole affair is a pitiful juggle, the effect of which is to delude the ignorant and unwary? And if there be a measure, why are we not told what it is? Again, it is said the transmissive power of the spikes increases with the length, but does not proceed beyond a certain limit, and three inches is the best length. But all this is unsupported assertion merely: the question is, *why*, as far as theory is concerned, there should be a limit to the beneficial length of the spikes. The spikes, we are told, operate in promoting evaporation by virtue of their surface—their heat-receiving and absorbing surface, as it is called. A spike three inches long is alleged to be better than a spike two inches long, because it has more surface; should not, then, a six-inch spike be better than a three-inch spike, for the same reason? It is no answer to tell us that such is not the case. The question is, *why* is it not the case? Why, if spike surface be beneficial at all, should twenty square inches not be better than ten?

Turn we now to what our correspondent A. S. advances in favour of the spike system. He begins by admitting the truth of the observation we made in our former article upon these projects, namely, that the spike theory is incompatible with the received theory of conduction, and that, therefore, one of the two must be wrong; but he adds that it is the received theory and all the world that is wrong, and the spike theory and Mr. Williams that are right. His line of argument is as follows:—

The experiments of M. Delarive, says he, show that the conducting power of some fibrous substances varies exceedingly, according as conduction takes place in a direction transverse or parallel to their fibres. Wrought iron, being a fibrous substance, may fall under the same law, so that heat may be able to penetrate much better in the direction of the fibres, as in the longitudinal direction of a rod, than across the laminæ or fibres, as through the thickness of a boilèr plate. He further says that it has been found that increasing the dimensions of a conducting substance in the direction of the conduction produces only a slight retardation in the passage of the heat; a fact, he says, sufficient to destroy all confidence in reasonings founded upon the ordinary hypothesis: that, therefore, the power of transmitting heat may depend on something more than mere difference of temperature; and the spikes may, consequently, be beneficial.

All this, though extremely hypothetical, is very specious; yet it admits, we conceive, of a very satisfactory and obvious reply. If, as A. S. assumes, heat penetrates with unusual facility in the direction of the fibres of wrought iron, it might certainly be conceived to be desirable to insert in the plate iron of the flue discs sliced from the end of an iron bar, or for forming the flue of iron, the fibres of which lay in the direction in which the heat was required to penetrate. But to justify the use of the spikes, it is necessary to suppose not merely that heat is transmitted more rapidly in the direction of the fibres than transversely to them, but that heat is transmitted more rapidly through a spike three inches long in the direction of the fibres, than through a spike half an inch long in the direction of the fibres. If the doctrine advocated by A. S. be correct, we may conceive that if all the spikes of a boiler were cut off at the level of the surface of the plate, the discs of iron left in the plate might render the flue surface more pervious to the heat, on account of the greater conducting power of the iron in the direction of the fibres. But this increased permeability would be impaired or extinguished, if the heat had to travel through a distance of several inches of spike before it reached the plane of the flue surface; unless, as we have already stated, it be held that the heat travels quicker through a very thick than through a very thin piece of iron in the direction of the fibres, an idea too preposterous to be entertained for a moment. Instead, therefore, of the argument of A. S. proving the advantage of the spikes, it rather proves that if they be already inserted in any boiler they should be all cut off.

But further; A. S. asserts that no regard is to be had to the received theory of conduction, because an increment in the dimensions of a body in the direction of the conduction only slightly retards the propagation of heat; in other words, because the increment of dimension and the retardation of conduction do not vary in the same ratio. But what of that? The common doctrine of conduction does not specify any particular ratio in which this variation shall necessarily take place. It only says that heat is transmitted through a thin piece of iron more rapidly than through a thick piece of iron, and that more heat is communicated by a square inch surface of hot iron than by a square inch surface of cold iron. In this sense it is rather to be accepted as a self-evident truth than as a questionable hypothesis; and the endeavour to overturn this doctrine is plainly quite as hopeless as the attempt would be to disprove the most obvious truth in the whole range of our experience. Besides, if conduction do not vary as the temperatures simply, it must vary as the temperatures and masses conjointly. The quantity of heat, or what is equivalent, the quantity of matter, in a body will then become an element of the rapidity with which heat is communicated; and the admission of this element immediately throws us upon the "imperial absurdities" to which we have already adverted.

But perhaps the most extraordinary proof of the hollowness of A. S's doctrine is the fact that he is himself, it would appear, unable to listen to the consolation it affords. No sooner is the new doctrine propounded than it is thrown overboard, as a thing of no worth or moment, and our credibility is solicited in favour of another doctrine, which, we are assured, is so much in accordance with the laws of nature, that it ought rather to be adduced as an explanation than adopted as a hypothesis. This doctrine is only a reproduction of that analysed in our former remarks, as proceeding on the assumption that there is a stratum of cool air in the flues resting upon a stratum of hot air—a supposition which we showed was just as much in accordance with the laws of nature as that a stratum of water should swim on a stratum of oil. The hot air, impelled upwards by its buoyancy, will always rise to the upper part of the flue, and as soon as it is no longer hot from the transfer of its heat to the water of the boiler, it will descend by the sides of the flue to the level proper to its temperature, without any considerable intermingling of the particles of the ascending and descending currents, as supposed by A. S., and therefore without any considerable tendency from that cause towards an equalization of their respective temperatures. Nor can the rapidity of the current of the hot air through the flues interfere with the economy of these molecular movements; the current through the flues being merely a relative motion of the hot air and the boiler, and not of the particles of the hot air with respect to one another.

This explanation, then, of the rationality of the spike system entirely fails; but even if it did not fail it would be nothing to the purpose, for this doctrine of the mode of action of the spikes, whether good or bad, is not the doctrine of Mr. Williams. It is not the thing to which he has called upon us to yield our assent, and is, therefore, not the thing into which it has been our present purpose to inquire. We come back, then, to the very point from which we started. We have no alternative but to admit that the received theory of conduction as we have explained it is right, and it is equally inevitable that we believe the spike theory to be wrong, and this gentleman's whole project an ineffable absurdity.

We have hitherto confined our remarks to theoretical considerations only: were we to extend them to the practical bearings of the subject, the scheme would appear more preposterous still. And first it might be remarked, that all the spike theory *professes* to accomplish is to diminish, in some measure, the quantity of flue surface requisite to produce a certain evaporative effect. It does not profess to save fuel—to aid combustion—to increase the efficacy of the steam, or to diminish the expense of maintenance. Supposing even, therefore, the spike theory to be correct—supposing that a square foot of flue surface spiked were superior in evaporative efficacy to a square foot of flue surface unspiked, we do not believe that any practical man, whose opinion is entitled to respect, would recommend the adoption of the spiked surface. And the reason is obvious: the same benefit the spikes profess to confer is attainable by simpler and more trustworthy methods. Who is there among practical men prepared to maintain that a moderate extension of the flue surface, or the employment of an appliance to enable the feed water to extract the superfluous heat from the hot air proceeding to the chimney—expedients whose simplicity is obvious, and whose efficacy has been established by the experience of a century—is not more safe, and in every respect greatly preferable to this expensive, inconvenient, and untested innovation? A flue surface studded with spikes would not only be more difficult to make tight in the first instance, but would be almost impossible to keep tight in those situations where the heat was great. It is well known to practical men, that in the furnaces of marine and locomotive boilers even rows of rivets are objectionable, and are as much as possible avoided; and the head or nut of a bolt in the same situation is found to be very quickly worn away by the rapid oxidation its high temperature induces. If such be the fate of a piece of iron projecting only an inch from the surface of the plate composing the flue or furnace, what might be expected to become of a piece of iron in the same situation which projected three inches above the plate surface? How long might a spike be expected to last, where even a bolt head is quickly burned away? We might proceed to show, that the spiking of flues would not merely render repairs more frequent, but also more difficult—that it would be inconvenient to clean, and in some measure dangerous to meddle with flues studded with these Caledonian stilettos, fresh from the armoury of Dircks and Co.—the unfortunate sweep or boiler-mender being reduced to much the same condition as Regulus in his barrel of nails, or as a heretic on the eve of being impaled upon the pious spike surfaces of the martyrology. We might also show that the salt which collects in the flues of marine boilers wherever there is a leak could only be detached from the spikes with great difficulty, some of the spikes, too, being probably broken in the attempt. But we feel that it would be a useless multiplication of words to enter upon such topics; we have drawn the veil sufficiently aside to show the fallacy and folly of this project, and we leave those parts of it which it would be superfluous to expose, to the judgment or compassion of our readers.

We had almost forgot to mention that the application of spikes to boilers is not a new idea. Spike boilers were in use many years ago in the United States—that hot-bed of preposterous subjects—and we are told that a spike boiler is described and figured in Gordon's book on locomotion. Such boilers of course did not answer. Mr. Beale of Greenwich attempted to rationalize the scheme ten years ago, by making the spikes hollow and filling them with water. But even with this modification, the project was found unproductive of benefit, and highly objectionable in many respects. After much labour and capital had been uselessly expended, it was in consequence abandoned.

Let us now proceed to render indelible our former remarks upon the illusory nature of the smoke-preventive project. The pretensions of this scheme to a superiority over all pre-existing schemes rest chiefly upon the allegation, that it is not smoke which is attempted to be consumed, but gas. We admitted, it will be remembered, the superiority of the smoke-preventive principle over that which has for its object the combustion of smoke, and we expressed our readiness to give this gentleman whatever credit might appear due to him, either for having been the first to propound that principle, or the first to practically apply it. But we denied that the principle of smoke-prevention was even attempted to be carried out in this gentleman's furnace—that his furnace could not therefore possess any superiority upon that score; and we showed that smoke-prevention had, previously to Mr. Williams' expositions, been advocated in an essay attributed to Mr. Bourne. These statements, if substantiated, will certainly reduce Mr. Williams' merits to a superficies differing from nonentity by a quantity incalculably small. Let us examine what is urged in opposition to them.

The difference between smoke and gas, it will be recollected, we stated was, that the one was the product of imperfect combustion, and the other was not the product of combustion at all, but of distillation merely; and we said that for this gentleman's furnace to be a smoke-preventive furnace it was indispensable that no combustion should be carried on in it—a condition we showed to be incompatible with any conceivable mode of working a furnace so constructed. We argued then that combustion must be carried on in this gentleman's furnace, if it were in action at all; and that it would be a mere delusion to pretend that because there were doors to the ash pit the fire could therefore be kept alive without a supply of air. To this Mr. Williams replies, that he is guilty of no such absurdity as that of excluding the air from the ash pit altogether; and that the doors he places upon his ash pit are merely for the purpose of regulating its admission. In other words, it would appear that the use of these mysterious doors is merely to regulate the draught—a purpose which a single damper in the chimney would accomplish. It would further appear to be admitted that air is allowed to enter the furnace, and that combustion is carried on therein; so that it is smoke, not gas, which this gentleman attempts to consume, and his furnace is, therefore, virtually admitted to be a mere smoke-burning furnace, as we proved it to be in our former analysis.

In our previous observations we remarked that one of the most serious objections to all smoke-burning plans was the necessity of admitting an excess of air into some part of the flue or furnace, the refrigeratory effect of which materially detracted from the calorific efficacy of the combustible parts of the smoke. Mr. Williams informs us, that in his plan an excess of air is unnecessary, *because* the air is thoroughly diffused; and he is kind enough to hint at the "chemical error" we are supposed to have committed in supposing an excess of air to be indispensable, inasmuch as an excess of air, he says, is rather a serious impediment than a necessary aid to combustion. We feel that an apology is due to our readers for entering upon the demonstration of truths with which every schoolboy is familiar; but we have *no alternative* between leaving this gentleman unconverted and descending to expositions which every one of common capacity will esteem as trite, obvious, and insignificant.

The necessity for the admission of an excess of air, then, to accomplish the combustion of the imflammable matters existent in smoke, does not arise from an unequal diffusion of the air among the smoke, but from the co-existence of a large quantity of uninflammable gas, the product of combustion, which is commingled with the matters sought to be burned. To descend to the phraseology of Mr. Williams, the uninflammable gas operates unfavourably upon the combustion of the inflammable gas *mechanically* by the interposition of its atoms, and *chemically* by the absorption of heat. The latter of these evils might be obviated by raising the uninflammable gas to a high temperature, but the former is insuperable so long as the quantity of oxygen is unvaried, and is greater in amount in proportion as the quantity of uninflammable gas is large. To take an extreme case; suppose that in every cubic inch of smoke there were only an atom of combustible matter present—the rest being all incombustible gas arising from combustion—and suppose that to every cubic inch of smoke two atoms of oxygen were admitted; what chance would there be that these two atoms of oxygen would come into sufficient proximity to the combustible atom to fulfil the conditions indispensable to combination? It is idle to talk of diffusion as a remedy for this evil; the difficulty is not that the gases are insufficiently mixed—for we have supposed the mixture to be homogeneous—but that the atoms are too far apart, and that an incombustible substance is interposed, which separates the atoms to be combined as effectually as if there were a wall or partition between them. This difficulty is only to be mitigated either by increasing the proportion of the combining substances, so as to render the quantity of the incombustible gas relatively less, or by so increasing the quantity of the supporter of combustion as to afford some reasonable prospect that the combustible atoms, when equably diffused, will be sufficiently near *some* of the atoms of the supporter to be within the range of combining attraction. The latter expedient is the only one available in practice, and this expedient is in effect neither more nor less than the admission of an excess of air into the flue or furnace, the word "excess" meaning a greater quantity than is proper to atomic saturation. In all smoke-burning furnaces, then, it is necessary to admit an *excess* of air into some part of the flue or furnace, to accomplish the combustion of the inflammable parts of the smoke; and this excess of air, by its cooling agency, diminishes the available quantity of heat the combustible parts of the smoke would otherwise surrender. Any diffusion appliance, whatever be its merit, leaves this difficulty untouched; and this, the chief obstacle to the success of all smoke-burning projects, attaches as much to this gentleman's furnace as to any other.

But further; Mr. Williams observes "I am told the sole peculiarity of my plan is that the air enters by a greater number of holes than usual. Will the reviewer inform your readers whether this peculiarity be not the very one which characterizes the Argand burner? Again, whether of two smoke-burning projects the least objectionable is that which admits the air at one hole or at many holes, it would be irrelevant to inquire. Now, Sir, that is the real point worth inquiring into, and this blinking the main question at issue will not go down with your scientific readers." If our scientific readers do not do more than blink at this exposition, the fault certainly does not lie with Mr. Williams. We thought the question had been whether this gentleman's furnace were a smoke-burning or a smoke-preventing furnace; but it would appear that the claim to the title of a smoke-preventing furnace is relinquished, and the real point now to be determined is whether this smoke-burning furnace is better or worse than other smoke-burning furnaces. This is at least intelligible; yet in the face of this announcement, and in the very same paragraph, we are told that this furnace is no more a smoke-burning furnace than the Argand burner is a smoke-burning lamp. The Argand lamp and the Argand furnace, we are told, very closely resemble one other—and in what respect? there are small holes in both.

In our former remarks, we stated that it was smoke, not gas, that was generated in this gentleman's furnace; and that whether the air were admitted by one hole or by a thousand holes, the nature of the thing to which it was admitted could not be altered thereby. But because an Argand burner consists of a tube perforated with small holes, and is a smoke-preventing arrangement, this gentleman's diffusion apparatus, being also composed of tubes perforated with small holes, is said to be a smoke-preventive arrangement likewise. The substance to which air is supplied through one hole, though smoke, is no sooner supplied with air through many holes than it immediately is turned into gas; so that we have only to apply this very reasonable doctrine to prove that the infusion which, when made in an ordinary vessel, we are wont to distinguish by the term coffee, will inevitably be transformed into chocolate, or something still more wonderful, if made in a coffee-pot distinguished by small holes of the patent diffusion description.

We are perfectly aware, in common with every one who has not been educated in Caffraria or Timbuctoo, that gas may be burned with smoke or without smoke; and we are willing to admit—if the admission will gratify this gentleman—that the Argand burners of Regent-street are much better calculated to promote perfect combustion than the barbarous expedients of the butchers' stalls. But the question is not which of these appliances is calculated to accomplish combustion most completely, but whether the aëriform matter proceeding from the orifices of the Argand burner and from the pipe of the butcher's stall is the same or different: whether if the gas, as it emerges from the orifices of the respective tubes, were to be separately collected and analysed, it would be in the one case found to be genuine and veritable gas, and in the other smoke merely. That such would be found to be the case we do not believe. We do not believe that the circumstance of aëriform matter, or any other matter, being made to flow through a large hole, or through a small hole, can change its specific and proper character—that the size of the orifice through which it escapes determines whether a substance is smoke or gas, or whether a furnace is a smoke-burning or a smoke-preventing one. To talk about Argand burners, as if any species of burner could convert a gasometer of smoke into a gasometer of gas, is idle and ridiculous; and to compare a furnace with an Argand burner because it is furnished with small holes, is just about as rational as to compare it with a patent coffee-pot, or a kitchen strainer—inventions which participate in the same distinctions.

But an excess of air, it is said, is unfavourable to combustion. We know it well. Too much air, if admitted into the flue or furnace of a boiler, will augment the generation of smoke as effectually as too little; but this is caused not by an excess of oxygen, but by a defect of temperature, and has no more relation to the question before us than the allegation that though a candle to burn properly must be surrounded by air, yet a blast of air will extinguish it. In practice so much cold air may be admitted into a furnace that its temperature will fall beneath the point necessary for the inflammation of the combustible gases evolved, and their combustion may thus be prevented, not by an excess of oxygen, but by a destitution of heat. But the quantity of cold air to which this effect is due is much greater in amount than the excess requisite for the combustion of the smoke; and the inflammation of the gases may be maintained either by diminishing the quantity of air admitted, or by elevating its temperature. The antiphlogistic property of the influent air, then, is not one of its specific and necessary characteristics, but one accidental to its temperature merely, and does not in the least invalidate the necessity of admitting air to smoke *in excess*, to achieve the combustion of its inflammable portion.

To correct the impracticability of apportioning the admission of air in an ordinary smoke-burning furnace to the perpetual fluctuations in the quantity of smoke evolved, Mr. Williams says "I separate the air into two supplies, thus rendering them more manageable, and what is more important, less liable to interfere with and mar each other's objects; a system, too, which has also this practical value—the causing them to be to a great extent mutual correctors of each other's defects." This intimation has certainly the merit of being hieroglyphical and cabalistic enough to defy criticism, and precludes any very specific rejoinder. We must, therefore, be content to remark, that as it is an intimate admixture between the atmospheric air and the gaseous matter, whatever be its nature, which proceeds from the fire, that this gentleman professes to accomplish, his arrangements, supposing them to perfectly attain that object, and that smoke-burning is assumed to be desirable, will be valuable or not, just in proportion as the same end is attainable or unattainable, by other or simpler means. Now, the admission of a sufficient quantity of air to the smoke, or the thorough diffusion of that air, has never been found to be a point of difficulty. Indeed there is no furnace whatever, in which, by a proper regulation of the draught and of the depth of coal upon the grate, *any* quantity of oxygen may not be enabled to ascend to the smoke through the fire. In scarcely any furnace does all the oxygen which enters the ash pit enter into combination with the fuel; a part almost always escapes in its uncombined state through the burning embers, and by the mere regulation of the draught and of the thickness of the incandescent stratum, this quantity of oxygen may be made as great or as small as may be desired. As this oxygen ascends not in one part of the grate, but through every part of it, it must be necessarily equably diffused among the incombustible gases and inflammable substances present, and must, moreover, be of as high a temperature as the fire in its passage is able to impart. If this adequate supply of oxygen equably diffused among the smoke be attainable in any ordinary furnace—and that it is must be perfectly self-evident—wherein lies the necessity or benefit of this gentleman's diffusion apparatus? Not only can the requisite quantity of oxygen be let in to the smoke through the fire, and be equally well diffused without any apparatus at all, but the oxygen so let in will, moreover, be of a high temperature—a condition highly favourable to combustion. As to the air being admitted in two supplies or in a hundred supplies, that point is one of perfect unimportance. The only point of moment is whether the requisite supply of oxygen is present, and that oxygen is equably diffused; and if this condition be fulfilled, it matters not one iota how the oxygen got there, or by what means its diffusion has been accomplished—whether by the instrumentality of diffusion orifices, or whether it has made its way through the interstices of incandescent fuel upon the bars of the grate.

We spoke so fully in our former remarks of the inherent and necessary defects of smoke-burning arrangements generally, that it would be superfluous now to say anything more upon the subject. This gentleman's invitation to investigate the merits of different smoke-burning schemes, if accepted, would lead us into an invidious and unprofitable discussion. Of two plans positively injurious, there is little advantage to be conferred by showing that one is rather worse than the other. It is sufficient to show that both are worse than the methods most known and practised, and are, therefore, undeserving of further attention. Furnaces of the ordinary description will produce very little smoke, if the coals be spread thinly upon the bars, and the draught be pretty good; for in that case a sufficiency of oxygen will find its way through the fire to accomplish the combustion of the inflammable parts of the smoke. It is usual and beneficial to have a dead plate at the mouth of the furnace, and a few holes in the furnace doors, the purposes of which are obvious.

But it is time that we should turn to A. S., to ascertain what he is able to advance in favour of Mr. Williams' smoke-preventing pretensions. His whole argument rests upon the imputed fallacy of the definition of smoke given in our former article, and it is, therefore, sufficient for us to show, in reply, that the definition we there gave is the natural, universal, and correct one. We defined smoke to be "the product of imperfect combustion"—a definition A. S. altogether repudiates. "Smoke," says our correspondent, "is here defined to be the product of imperfect combustion; but what are we to understand by the term imperfect combustion? there is no such thing in nature. Who ever heard of imperfectly-formed carbonic acid or of steam without a saturating equivalent of oxygen?"

In saying that combustion, which is an act of chemical combination, is imperfect, we can only be supposed to mean that the process of combination, owing to the co-existence of some such agency, has not been perfected:—in other words, that although some of the atoms of the one body have entered into combination with some of the atoms of the other, yet that the remaining atoms have not entered into combinations, owing to their subjection to some such influences as those we have indicated. The use of the term imperfect combustion, then, does not involve the supposition that carbonic acid is imperfectly formed—although it is not certain that there may not be a species of combustion which generates carbonic oxide—but that the act of forming carbonic acid in quantity proper to ingredients present, has not been completed or perfected. Any other supposition would not only be gratuitous, but opposed to the whole tenor of chemical science, and it is difficult to suppose our correspondent to have *believed* that an opposite tenet was held by us.

But again, the term "imperfect combustion" is that employed by all chemical authorities, and what perhaps is more to the present purpose, it is that employed by Mr. Williams. We feel that it would weigh but little with our correspondent to adduce the authority of Sir H. Davy, Dr. Dalton, Berzelius, and Dr. Thomson, showing that smoke is the product of imperfect combustion caused either by the want of oxygen or the want of heat. But our correspondent cannot surely refuse to bow to the authority of Mr. Williams. Let him turn, then, to the 24th page of the appendix to Mr. Williams' treatise, and he will find an extract from the specification of his patent which runs thus:—"Smoke is the result of the IMPERFECT COMBUSTION of the volatile products." After this we feel it would be superfluous to say another word on the subject.

Our correspondent says that Mr. Williams' furnace has been very successful in practice, which is probably true enough, if we look upon success as the capability of being endured, or as a measure of beneficial effect, such as other smoke-burning schemes have succeeded in attaining. There is, perhaps, no smoke-burning scheme whatever of which the same thing may not be predicated as our correspondent alleges of this; for as we formerly mentioned, smoke-burning schemes may, with great care, be rendered instrumental in saving fuel, but in the aggregate of continued and ordinary working, there is always either a diminished efficiency or an increased consumption. In the evidence given before the committee of the House of Commons on the smoke nuisance, in the year 1819, a multitude of schemes are mentioned as having been found to answer extremely well, and some are said to have been then in successful operation in the large London breweries. Yet these same schemes have all been discontinued—a result hardly compatible with the supposition that their continued use had been found advantageous. Upon what principle we can form any other anticipation relative to this smoke-burning project, than that it, too, will be discontinued, so soon as the stimulus of novelty has subsided, we are altogether at a loss to imagine. Besides, if our correspondent be prepared to assert that this scheme has been beneficial in some cases, and we at once admit, under the qualifications we have stated, that such may be the case, is he prepared to deny that, in other instances, it has been detrimental? Has it not been discontinued already in several factories in Liverpool and Manchester, and was not its employment in the case of Messrs. Hamnett & Co.'s furnace, productive of serious injury to the boiler, from the alternations of temperature consequent upon the alternate streams of flame and cold air flowing from the diffusion orifices and impinging upon the iron of the boiler? It would be unfair, we admit, to condemn any scheme, because it may have failed once, or even several times; for the failure of a good plan may be induced by imperfect machinery, carelessness, or even design. But neither can the reputation of a few successful applications win our entire confidence, especially when the plan is unaccompanied by any manifestation of qualities adequate to the production of the alleged advantages. It is so manifestly the interest of patentees to exaggerate the merits of their own projects; and even where emolument is not an object, an ephemeral reputation is sometimes so highly valued, and the tendency of human nature to regard its own productions with partiality is so powerful and universal, that all representations coming from an interested party are to be received with caution. If this be the rule with rational projects, shall we dispense with its observance in the case of projects whose rationality is more than problematical? Shall we, upon the questionable authority of a patentee, accept statements as indisputable which not only transcend the bounds of credibility, but are inconsistent with the dictates of common sense?

To the charge which might be thought to be involved in our account of the extraordinary circumstances under which this gentleman's ideas relative to the superiority of the smoke-preventive principle, appear to have been developed, no defence or explanation is even attempted to be offered. We are told, indeed, that if smoke prevention be good under the auspices of Mr. Bourne, it cannot be bad under those of Mr. Williams, a proposition sufficiently self-evident, but altogether foreign to the question. The point to be determined is not whether Mr. Bourne's plan is good or bad—an inquiry with which we have nothing to do; but whether Mr. Williams did or did not obtain the ideas of Mr. Bourne in confidence, and appropriate them to his own uses. Upon this point Mr. Williams is silent. He does not say that Mr. Bourne's essay was not published anterior to his book, that Mr. Bourne's patent is not of an earlier date than his patent, and that antecedently to the dates of books or patents, Mr. Bourne did not communicate to him, in confidence, his ideas, upon the expediency, practicability, and advantage of the smoke preventive system. It is true that this system is not carried out in Mr. Williams' scheme, the proposed object being defeated by the injudicious character of the arrangements, and that therefore this furnace has no title to the character of a smoke-preventing one. But the desire that it should be such is palpable enough, and the existence of this desire and the boasted possession of smoke-preventive properties, are quite as conclusive, so far as this question is concerned, as if that desire and those properties had been actually realized. Whatever credit, then, is claimed upon this score of smoke prevention, or whatever credit is claimed for the announcement of the superiority and practicability of that system, is not merely unclaimable by this gentleman, but it is questionable whether he can extricate himself from all suspicion of having appropriated as his own what he must have known to be the property of another. It is true that the thing taken, supposing that the fact of such appropriation were established, is of little or no value; for the fact of the abstraction from one person of a smoke-preventing project and its appropriation or attempted appropriation by another, can hardly be supposed to be productive of much benefit to the one, or of much detriment to the other. But the insignificance of the value cannot influence our sentiments respecting the quality of the act, unless it be to suggest that if an insignificant object be capable of inducing a deviation from strict propriety, a more important inducement may be expected to render such deviations more extensive and less reluctant. As regards this case, we refrain from making any specific charge further than to say that Mr. Williams has not even noticed the statements we formerly made upon this branch of the subject, that those statements must therefore be supposed to be correct, and we are prepared to substantiate them by the fullest evidence, and that of the conclusions involved in those statements we must leave every reader to make his own estimate. We therefore dismiss the subject with the general remark, that the public is, we believe, perfectly capable of appreciating the merits of a projector who is indebted to his invention for his facts and to his memory for his inventions.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.

SECOND COURSE.—LECTURE IV. LAYING OUT RAILWAYS.

IN the preceding lectures the subject of the motive power had been much enlarged upon, from its necessarily influencing the manner of laying out a line. Mr. Vignoles said the student may be referred to study, at greater leisure and in detail, the principles laid down in the works of various authors on laying out both roads and railroads—M'Neill, Parnell, Navier, Tredgold, &c.—and the rules laid down by them may be taken as sound first principles, though modified at present by the improvement of motive power and other causes which could not have been known *a priori*. Railroads have so completely superseded many of the principal roads, and the public convenience has been thereby so much interfered with, that it becomes a matter of importance to run the trains as often as possible, and this becomes a new element in laying out a line of railway. Hitherto this has been done under the impression that the engines would always carry maximum loads, and though it is true that main lines radiating from the metropolis, into which a number of tributaries fall, may be laid out with a view to maximum loads, yet it becomes a consideration whether it would not be better in general to lay out railways with a view to the trains going often, and with light loads, and thereby to make the gradients suitable to the ground over which they pass. On this subject Mr. Tredgold has always judged soundly. Seventeen or eighteen years since he made various calculations on the comparative expense of ascending and descending inclined planes, and of cutting them down to a level; and he states, in his *Treatise on Railroads*, that it will be much less expensive to follow nearly the undulations of the surface, and "if a few examples (of the comparative expense) be added, it will assist in removing those extravagant notions of cutting and embankments, by which the capital of the country is wasted in unprofitable speculations." But the practice of engineers has been directly opposed to this, although we had almost a daily improvement in locomotive power, affording means of overcoming the difficulties of steep gradients. Before determining upon the inclinations which he will adopt, therefore, the engineer should make estimates of the comparative expense of forming and working flat gradients, and gradients of an inferior description, and it will be found that gradients of 50, 60, and even 80 feet in a mile, may be advantageously introduced, especially where the traffic is not very considerable. And if lines were laid out upon these principles, instead of the traveller being overcharged with the expense of the capital sunk, as at present, he would be charged with the expense of the motive power, which bears a very small proportion to the total amount exacted from passengers. Locomotive power only is scarcely more than ¼*d.* per passenger per mile, whereas the ordinary charge to passengers is 2*d.*; and this may explain why railway companies do not lease the working of their lines, for they make most of their profit as carriers, and not as capitalists.

In laying out railways there are generally two distinctive descriptions of country which the engineer meets with, each of which requires a different description of treatment with respect to his operations. The first is where there is a certain summit or ridge of country to be surmounted; the rule in this case will apply both to roads and railroads—viz., to get a uniform inclination, if possible, up to the summit; but if that be not practicable, to lay out the line in stages, taking care that, having once attained any intermediate elevation, the line does not, if possible, descend again. In a country of this description there will be much more difficulty in the details than in striking out the first general idea, for it will require the greatest care and patience to lay out the line so as to ascend to the summit at the least possible expense, by winding along the sides of hills, and crossing lateral valleys and ravines to the greatest advantage, &c.

The other description of country is where the extreme points of the line to be laid are on a level, or nearly so, and the ground varies. In this case his judgment will be principally exercised in determining the general direction of the road, in taking trial levels to determine the line of least cutting and embankment, in avoiding valuable property, and in securing the largest amount of traffic; and in a country like England, which is so full of improvements, gentlemen's seats, roads, streams, &c., it is an exceedingly complicated duty to make choice of the best line under such circumstances; but it may be laid down as a general rule, that in any difficulty it is always better to incur a positive known expense, which will not entail future liability, than by diminishing the expense in the first instance to run the risk of undergoing future loss. Thus, for example, if a line of railway upon a slight embankment should cross a road on the surface of a wet or marshy country, it will be better to raise the road to a sufficient elevation to pass it over the railway, though the height of the bridge and approaches be thereby greatly increased, than by slightly lowering and passing it under the railway at a greatly reduced expense, to render it liable to be continually laid under water. And these are the kind of circumstances that require so much care and consideration on the part of the engineer, to enable him to judge of the comparative amount of cost and maintenance of the different systems which he can adopt, and to regulate his designs accordingly. Now we might go on thus increasing railway gradients until they approached nearer and nearer to those of a turnpike road, were it not for the difficulty of regulating the descent of them with safety. On a turnpike-road, writers have suggested that from 1 in 36 to 1 in 40 is the best slope, because horses may gallop down without danger, and, at the same time, it is a good trotting road upwards. But on railways it is not safe to go down such inclinations as that. Professor Barlow lays down that when the inclination is greater than 1 in 100 all advantage from gravity in the descent is lost, from the necessity of applying the break, and he has formed tables to show the amount of loss sustained in the ascent; thus, he states, that going up one mile of 1 in 100 is equivalent (of course with a maximum load) to going 2½ miles upon a level; but he will not allow that any corresponding advantage is gained in the descent of this, or any plane steeper than about 1 in 180. Now, if this be the case, we must have a totally different set of elements in forming lines of railway from what I have been laying down. But, as has been already stated, this is not the case in practice, for trains can have, with perfect safety, the full benefit of gravity on all descents up to 1 in 100, and the engines seldom carry maximum loads. The same line of argument has been pursued with respect to turnpike-roads, where, however, there are many circumstances in operation which do not occur on railways—such as the unsteadiness of horses and coachmen, which influence the question; but the great point to be considered is whether it is most economical to lay out railways with respect to stationary or to locomotive power. On this subject M. Navier very sensibly remarks, that great rapidity being the characteristic of railways, it has been considered necessary to employ locomotive engines, which system presents an important advantage in being able to increase gradually the number of engines as the demands of commerce require it, whereas, on the stationary system, it is necessary to provide at once for the greatest amount of traffic that can ever occur. But in the event of this increase, we have still the means of using light and frequent trains for transporting a heavy traffic over a line of inferior gradients, and reducing the charge of the interest of that capital to the public. But whatever be the description of country which the engineer may meet with, he should first of all make or procure detailed plans on the largest scale, and upon them lay down a number of surface levels, and from them, as from a model, to find the line of least expense and greatest accommodation. The magnificent Ordnance Maps of Ireland, from their great scale and numerous surface levels, will render the task of the engineer in that respect easy, should the long-deferred introduction of railways into that country be ever carried.

LECTURE V.—ON THE COMPARATIVE ADVANTAGES OF DIFFERENT RAILWAYS.

The class will, no doubt, be inclined to think that I have dwelt too long in the first four lectures of the present course, upon the principles of economy in motive power, but I assure you, that if, in after years, any of you follow up the profession, you will find the subject one of the most vital importance. I shall this evening draw your attention to the different elements of comparison which should guide the engineer in forming a selection from different proposed lines of railway, and shall take, as a text-book for that purpose, Mr. M'Neil,s translation of M. Navier's work *On the Means of Comparing the Respective Advantages of Different Lines of Railway*—a work which I highly recommend for your private study, on account of the clearness and accuracy of the views it contains. M. Navier states "that the elements of comparison of different lines of railway may be divided into two heads; first, the establishment of a very rapid mode of transport—a consideration which should give a preference to the shortest lines, the velocity being supposed to be the same in all; second, the increase of wealth which may result from the establishment of a line of railway. The construction of a railway, like that of a common road or a canal, is favourable to the advancement of wealth; in the first place, because the actual expense of transport in this direction is diminished; and, in the second place, because this diminution in the cost of transport increases the value of the neighbouring properties, facilitates the establishment of new works, and increases production;" and the saving effected is not merely a private advantage to those individuals who may be directly benefitted by it, but is so much actual increase of the wealth of the country at large. "The first of these effects—that is to say, the diminution obtained on the actual cost of transport—is the cause of the second, so that this diminution is the principal circumstance, and that which should be principally considered." Taking it as established, therefore, that diminution in the cost of transport is the principal thing, we come to the result that the cost of motive power, on which this is dependent, is the leading point to be attended to in the formation of any line of railway. Indeed, M. Navier goes so far as to say that this is almost the only circumstance to be attended to; in his own words, "we should even say that the rate of reduction which is obtained upon the actual cost of transport, by the establishment of a new communication, is almost the only circumstance which should be thought of;" but he goes on to say, very justly, "it is also necessary to consider the quantity of goods which is carried, or which may be carried hereafter, in this direction," for the very essence of the railway system is to increase its own traffic; "for it is evident that it may be less advantageous to the country to produce a great economy in the cost of transport upon a line where there is but little to carry, and more advantageous to produce a less economy upon a line where a large quantity of merchandise is carried." These are the principles which I have been endeavouring to impress upon your minds, and which, from their importance, I cannot too often repeat. "It is, therefore," says M. Navier, "generally necessary to take into consideration, in the comparison of different lines, the quantity of traffic which may be established on each, and even the increase in the value of properties, and the development of production to which the establishment of these lines may give rise respectively, according to the nature of the countries which they traverse." I would observe, as a passing remark, that the word *developpement*, in French, generally refers to length; thus the development of a line of railway will be spoken of—meaning the length of that line—whilst, in English, the word refers to an extension of superficies. M. Navier does not go minutely into the examination of these last elements of the question, which rather belong to statistics and political economy than to engineering, but confines himself to the "consideration of the reduction which the establishment of a railway can effect upon the actual cost of transport—a most important consideration—to which, as already remarked, it is always necessary to attend; and this will form, in every case, the principal element of the comparison between different lines, and often leads to determinations purely geometrical or mechanical, and, consequently, exempt from arbitrary deductions."

M. Navier then goes on to state, that "the cost of transport on a railway, as upon a road or canal, depends on two principal points, which it is necessary to distinguish and consider separately; the first of these is the expense of constructing the railway, and the second is the expense of conveying the goods on the railway, when it is constructed. The expense of the construction of the railway is independent of the quantity of merchandise and of passengers that will pass over it. The expense of transport, properly speaking, upon the railway supposed to be constructed, depends, on the contrary, upon the quantity of merchandise or of passengers—that is to say, all other things being equal, the expense will evidently be in proportion to the tonnage." Now, a few years back, the whole time of the House of Commons was taken up with comparing the merits of rival lines of railway, for no sooner was one line proposed than directly a rival line was started. It is well known that, for the Brighton Railway, four different lines were proposed—the discussion on the respective merits of which extended over a considerable length of time. But it is a curious fact, that, in all these discussions, the principle which has been laid down this evening was never once alluded to. Now, in the practical working of railways, the diminution of expense of transport is generally quite independent of the quantity of goods carried, for, after a line is constructed, the charges are generally arranged with reference to rival lines, or to the competition which may exist with the railway; and the interest of the money laid out is scarcely thought of, however much it may have entered into the *a priori* calculations. The Paris and Versailles Railways may be mentioned; two lines were started, one on each side of the river—the Government did not like to treat either party harshly, and passed both bills, and both lines are actually executed; and, from the great competition between them, the charges for transport of goods and passengers will probably bear little or no relation to the interest of the capital expended. There is, however, another element which renders the calculation of a very complicated nature. The railways are different from common roads or canals, over which, after they have been once constructed, the public have been left to find their own way—considerations of public safety render it necessary to incur great expenses in terminal and local stations, &c.; and there are also secondary expenses, such as the annual cost of repairs, police, and management, of which it may be said that they depend partly on the interest of the cost of constructing, and partly on the amount of tonnage carried. Now, from experience a general idea can be formed of the expense of these items, but, before going into the details, I will return to M. Navier, who says—"We may, therefore, admit, without falling into any serious error, that the annual cost of transport on a railway is, in all cases, formed of two parts—the one proportional to the expenses of the construction of the way, and the other proportional to the amount of tonnage carried; and we should also observe, that the cost of transport of one ton of merchandise cannot be specified, unless the number of tons which shall be carried annually from one extremity of the line to the other be known." Now, hitherto we have been unable to determine *a priori* what these amounts are—but we can tell with great accuracy what they have been on the different lines of railway now in operation. The following tables give the average of these expenses on several lines of railway:—

MERCHANDISE TRAFFIC.

Heads of charge.	Coal on colliery railways in the north.	Goods on the Liverpool and Manch. Rlwy.
Locomotive power—wages and repairs	0·355*	0·425*
" fuel	0·025	0·125
Total	0·380	0·550
Wagons	0·190	0 227
Conducting traffic	0 075	1·080
Maintaining railway	0·208	0·307
General expenses	0·100	0 354
Total cost	0·953	2·518

* Per ton per mile—in decimals of a penny.

PASSENGER TRAFFIC.

Heads of charge.	Lond. & Manc. Railw.—average 60 passengers per train.	Dublin & Kingstown Railw.—av. 40 passengers per train.
Locomotive power—wages and repairs	0·170*	0·173*
" fuel	0·100	0·115
Total	0·270	0·288
Coaches	0·054	0·031
Conducting coaching	0·104	0·113
Maintaining railway	0·085	0·050
General expenses	0·091	0·174
Total cost	0·604	0·656

* Per passenger per mile—in decimals of a penny.

Taking the Liverpool and Manchester Railway as an example, we find the number of passengers to average sixty per train. This may, on the whole, be considered as a fair average on all the railroads throughout the country. Seven years working of the same railway gives, as the average expense of locomotive power, 0·27*d.* or about ¼*d.* per passenger per mile. The gradients do not exceed six or seven feet per mile, with the exception of the inclined plane, and this also is an average amount for most railways—in fact, fuel and wages are so nearly the same on all lines, that the expense of this head can be calculated with great exactness. The expense of locomotive power, also, is the only one which depends upon the gradients. The other expenses, which are independent of the gradients, are—coaching, conducting ditto, maintaining way, and general expenses, altogether amounting to 0·33*d.*, which added to 0·27*d.* = 0·60*d.*, or, in round numbers, three-fifths of a penny per passenger per mile for the expense of transport. Now, let us examine the relative expense of the merchandize traffic. We have, for the expense of locomotive power, 0·55*d.*, or, in round numbers, ½*d.* per ton per mile; for the cost of wagons and secondary expenses, 1·97*d.*, which, added to 0·55*d.*, gives 2·52*d.*, or, in round numbers, 2½*d.* per ton per mile as the actual cost of transport. Now, let us mark the very striking result of this comparison. Even with all the most recent improvements, and cutting down every expense that can be reduced, the mere transport of passengers costs three-fifths of a penny per passenger per mile, whilst that of goods is only 2½*d.* per ton for the same distance, and of this 1*d.* may be thrown out, arising from other sources, leaving the cost of transport—passengers, three fifths of a penny per passenger per mile; goods, 1½*d.* per ton per mile. In the first case, we have an amount exceedingly high, in proportion to the present means of transport, whilst the second case presents a result as strikingly low. A ton of goods is equivalent to the weight of fourteen passengers, with 30 lbs. of luggage each.

When the loads to be carried are light, and the velocities at which they are carried considerable, the steepness of the gradients is a matter of comparatively little consequence, but as soon as the engine is loaded to its maximum power, the railway system becomes unable to compete with the canals, so far as relates to the carriage of goods. If these are the results offered to you by past experience, do you not see at once how it affects the question of laying out lines in remote districts, where but a small amount of traffic can be calculated upon? Again, referring to the table, with reference to the difference between carrying slowly and carrying quickly, we find that the expense of locomotive power on the Liverpool and Manchester Railway is 0·55*d.*, or nearly three-fifths of a penny, yet that the expense upon the best railways, where goods are carried at a moderate velocity, is only 0·38*d.* and the remaining expenses 0·57*d.*, so that it comes to this, that we have—Liverpool and Manchester Railway, 2½*d.* per ton per mile; other railways, with moderate speeds, 1*d.* per ton per mile. M. Navier proposes a case not quite so strong, perhaps, as might be made out, and I will, therefore, refer to the Brighton Railroad for an example, the expense of which, for the 40 miles, has been about £2,600,000, or £60,000 per mile, the interest of which, at 6 per cent., is 10*l.* per mile per day, which is the net receipt, after all expenses are paid, requisite to insure a decent interest to the shareholders. I shall not enter further into the question now, but if those students who are sufficiently advanced will take up the subject, they will soon be able to appreciate my arguments for increasing the limits within which gradients are usually kept—for, supposing the expense of carrying a passenger should be only ⅗*d.* per mile, yet, if you will calculate the additional expense of the interest of £60,000 per mile, you will find ruinous results.

M. Navier having said that the cost of transport is the chief point to be attended to in laying out a railway, goes on to determine the amount of power requisite to draw a given train over a given railway. The elder students will, in connection with this subject, be aware of the opinion which has been pretty generally entertained amongst engineers, that a rise of twenty feet per mile is equivalent to a mile in length. M. Navier says—"Let us observe that, upon a horizontal line, the power required to draw a given weight is considered as being equal to almost the two-hundredth part of this weight;" but, as I have shown in a previous lecture, the formula for the expression of this power will be $\frac{F}{n}$ taking F as the friction per ton, and *n* the number of pounds in each ton, so that what M. Navier calls the two-hundredth part of the weight will be friction divided by the number of pounds in a ton. Taking the friction at 9 lb., we have $\frac{9}{2240}=\frac{1}{249}$ nearly. At 11 lb., $\frac{11}{2240}=\frac{1}{200}$; and I must here repeat what I have so often before stated to you, that, although experiments have been made, which give so low a friction as 4 lb. per ton, that, on an average, M. Navier is nearly right, when we take into consideration the numerous causes of friction. M. Navier considers the power required to draw a given weight "to be independent of the absolute velocity of transit, although there is reason to believe that the tractive power increases with the velocity." Now, it has been said that the friction is the same at all velocities. I cannot fully concur in this opinion. I think the axletree friction may be constant under all velocities, but that, from other causes, there appears to be, I will not call it an increase of friction, but an increase of resistance, the amount of which has not been satisfactorily determined. M. Navier goes on—"We conclude from this, that, in order to transport, with any velocity whatever, constant or variable, a weight, W, to a distance represented by *a* on a horizontal line, it is necessary to employ the power represented by $\frac{W}{200} \times a$—that is to say, the power necessary to raise the weight to the height $\frac{a}{200}$," or, in other words to transport a weight any given distance on a horizontal line, is equivalent to raising it the two-hundredth part of that distance in vertical height; and, although this is not quite correct, it is sufficiently so for general purposes. We have before assumed that it is the same thing to go a mile round as to go over a hill rising twenty feet in a mile. Now, a mile being 1760 yards, or 5280 feet, we have $\frac{W}{200} \times 5280$ as the power required, which is equal to raising the weight 26 ft. But as the friction varies, I think we have sufficient experience now to say it is about the same thing to rise 30 ft. in a mile as to go a mile round: but this is quite independent of the question, whether you should or should not allow on one hand, and deduct on the other, when the slope exceeds the angle of repose. I have explained to you, on previous occasions, the difference of opinion that exists on this point. Both Mr. Barlow and M. Navier allow the advantage up to a certain point, which they fix at about 1 in 180, beyond which point they consider the whole advantage gained to be destroyed by the necessity of putting on the break. Now, in practice, we do not find this to be the case, until we come to 1 in 80, or thereabouts; however, we may take, as a general rule, M. Navier's concluding words on this subject:—"The length of the line remaining the same, the amount of power consumed to effect the transit depends entirely upon the length of the line, and the difference of the level of its extreme points." The practical result which I have endeavoured to lay before you this evening is, that the cost of transport is the cost of the power combined with the interest of the original cost of the line, and that the calculation of this combined expense must form the element of comparison between different lines of railway.

CORROSION OF IRON IN STEAM BOILERS AND STOVE PIPES.

(From the Franklin Journal.)

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the Corrosion of Iron in Steam Boilers and Stove Pipes, where Anthracite is employed as fuel, Report :—

That they have gathered such information as lay in their power from those who have witnessed the corrosive action, and combined it with their own observations.

It appears that stove-pipes are frequently corroded in the course of a year or two, where they are not taken down or cleansed subsequent to their employment through the winter season. An instance is known in which 40 ft. of pipe were corroded and rendered a perfect colander in the course of two years. Nor does it appear always as a necessary condition that the place should be damp, although this is the case in a majority of instances, for in the corrosion just noticed, the proprietor stated that the stove was very dry. The corrosion rarely happens in an upright pipe, but usually in one lying horizontally, for where such corrosion had already commenced it was said, in one instance, to have been obviated by giving the pipe a slight inclination. Where it takes place in an upright pipe, it may arise from the flowing down of corroding matter from a horizontal layer of the same.

The same kind of corrosion is observable in steam boilers in which anthracite is employed as fuel, and not in those in which bituminous coal is used. That it does not arise from the intensity of the heat is shown from the fact, that it is greatest in the boiler-flues which lie horizontally at a distance from the fire. A corrosion is sometimes observed near the top of the smoke pipe in steamboats, but this may be attributed to the alternate action of heat, cold, air, and moisture.

It would appear then, that the corrosion is caused either by the vapours arising from the combustion of anthracite, or from matter carried up mechanically by the draft; or from both combined. That it does not proceed from uncondensable gaseous matter is proved by the occurrence of the corrosion only when a stove-pipe is no longer exposed to these vapours during the summer season, or where a boiler is cooled from intermitted fires. It does not arise from matter carried up mechanically, for this could only be ashes, and we know that the ashes of anthracite are of a dry nature; and without moisture, chemical action, or the corrosion, could not occur. It must, therefore, be produced from condensable vapours.

On examining the interior of a stove-pipe lying horizontally, whether corroded or not, we find a loose ashy deposit of a greyish brown colour; and where corrosion has taken place, the greater part is condensed into a solid mass, showing that it had absorbed water. Upon fracturing the solid material, small white crystals appear under the microscope, which are generally too imperfect to admit of recognising their form. By subliming the mass, a little empyreumatic oil and water are formed, but the greater part sublimed is an ammoniacal salt. Upon testing a solution of the ashes, it shows a large content of muriate and sulphate of ammonia, the former evidently in much greater quantity than the sulphate. After complete sublimation at a red heat, the ashy matter remaining appears to be nearly pure charcoal or lamp black, with a mere trace of coal ashes. From the qualitative tests made, it would appear that the ammoniacal salts constitute at least three-fourths of the whole mass. A mere trace of iron was detected.

From this content of saline matter, as well as from its nature, we are at no loss to account for the corrosion of iron where the air and moisture add their conjoint action; but it may be doubted whether the ashy matter has the power of absorbing moisture from an atmosphere of ordinary dryness, for in dry situations, it appears that there is usually no corrosion, and in the case noticed at the commencement of the report, it may be doubted whether the stove was dry.

How to obviate the corrosive action is a more difficult point to determine, unless the very simple process be resorted to of cleaning out stove-pipes every spring, and boiler-flues every few weeks. If the stove-pipes are required to remain standing with the sediment in them, then a previous internal coating of white lead, litharge, or red lead might probably answer the best purpose, since it would result in the production of chloride and sulphate of lead, while the ammonia would be driven off. The thin coating of these salts of lead might then prevent the contact and farther action of the ashy deposit. Experiments made at the U. S. Mint during the winter of 40-41, seem to show that a coating of lime on the interior of a pipe prevents corrosion, and it is said that a few stove manufacturers in this city are acquainted with the fact. The committee, however, in the face of these facts, are rather inclined to believe that the oxide of lead will prove more efficient, since the sulphate of lead is a wholly inert salt, and the chloride nearly insoluble, while the sulphate of lime is somewhat soluble, and the chloride of calcium very soluble, and therefore likely to produce corrosive action eventually. Still the operation of whitewashing is the simplest mode of obviating corrosion, and may be repeated at intervals.

The content of chlorine to such an extent as is developed by the above chemical examination, is interesting in a geological point of view, since it has not hitherto been found in chemical examinations of anthracite. Prof. H. D. Rogers, in 1836, pointed out the fact, that where heaps of refuse matter were burned near the coal mines, ammoniacal salts, and among them muriate of ammonia, are sublimed, and may be found among the ashes. Now we know that saline waters are obtained from the coal measures in the western district of Pennsylvania, and, moreover, it is the prevailing opinion among geologists that the coal series are marine deposits; we can, therefore, explain the origin of the muriate of ammonia in the ashy deposit arising from the combustion of anthracite, by attributing the chlorine to the presence of a trace of chloride of sodium (common salt) in the coal or its accompanying slate, or possibly in both. It is unnecessary to allude to the formation of ammonia, since it is a universal product to a greater or less extent of the dry distillation or combustion of every kind of coal.

This ammoniacal deposit is interesting in an economical point of view, since it accumulates in considerable quantity in a single season, and may be collected with facility. In one instance at least, ten pounds were removed from about eight to ten feet of pipe, which was the produce of three or four years, and hence, we may estimate the large amount that might be obtained from many hundred pipes in Philadelphia every season. It may be employed either for the manufacture of sal ammoniac by a very simple process of sublimation with a small quantity of a salt of lime, or it may be directly applied in powder or in solution to garden soils. The influence of ammoniacal salts in promoting luxuriant vegetation has long been known, but the admirable work of Prof. Liebig on Agricultural Chemistry has more completely developed their influence and importance. The material before us will unquestionably prove of great value to the gardener and florist, if properly applied to the soil; but it must not be forgotten that it is very rich in ammonia, and should therefore be employed sparingly.

By order of the Committee,

February 10, 1842. William Hamilton, Actuary.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

March 1.—William Cubitt, V.P., in the Chair.

"*Holborn Hill, and the Plans for its Improvement.*" By John Turner.

This communication chiefly consists of an examination of the various plans which have been suggested for diminishing the acclivity of that crowded thoroughfare. An idea of its thronged state is given from Mr. Whishaw's evidence before a Committee upon Metropolitan Improvements, in May, 1838, wherein he assumes the fair average annual amount of traffic between Fetter Lane and the Old Bailey at "20,000,000 pedestrians, 871,640 equestrians, 157,752 hackney coaches, 372,470 carts and wagons, 78,876 stages, 82,258 carriages, 135,842 omnibuses, 460,110 chaises and taxed carts, and 354,942 cabs." The necessity for ameliorating this great thoroughfare has been generally acknowledged, and great changes have been made in the locality since the rivulet called the "Old Bourne" took its course down the hill into the Fleet river, which at that time had wharfs on either side for landing goods from the barges, which came up as far as Holborn Bridge. About the year 1733 the arching over of the channel of the Fleet was commenced, and subsequently was extended to the Thames, forming at present one of the main sewers, having its outlet at Blackfriars Bridge. On arching over the Fleet the ground at the bottom of the hill was raised as much as possible; indeed all that can be done by filling up (having reference to the surrounding levels), would appear to have been done at various intervals.

The oldest plan mentioned by Mr. Turner is that by Mr. T. F. Taylor, in 1828. He proposed to divide the hill at the corner of Hatton Garden into three parts, and to continue the same up Skinner Street nearly to the Saracen's Head Inn; between these points an iron suspension bridge, with a level roadway, was to be erected wide enough to admit of two carriages abreast, leaving the footpaths and nearly all the houses undisturbed. The estimate for this plan was about £23,000.

In 1833 Mr. Turner proposed to construct a bridge or viaduct, upon arches, along the south side of Holborn Hill and Skinner Street, from Thavies Inn to Sea-coal Lane. The arches would have been available for warehouses upon the level of that half of the street which preserved its original position. On this plan it would have been necessary to take down all the houses on the south side from Shoe Lane to Farringdon Street; the others being modern, might have been raised. This plan was subsequently modified, and the width of the street increased to 70 feet, giving the viaduct 35 in breadth.

Mr. Moseley's proposition in 1833 was to fill up the valley to the height of 12 feet at Holborn Bridge, altering some of the houses at the bottom. In 1840 he further proposed to take 18 inches off the brow of Holborn Hill and 12 inches off Skinner Street, which, with raising the bottom, would bring the gradient of the acclivity to about 1 in 35.

Some interesting tables are given of the rates of acclivities of some of the principal thoroughfares in London.

St. James's Street, at 660 feet from Piccadilly, is		1 in 27
Waterloo Place, ending at Piccadilly		1 „ 25
Haymarket, at 490 feet from ditto		1 „ 22
Strand, opposite Northumberland House		1 „ 33
Charing Cross, from ditto towards Whitehall		1 „ 37
Southampton Street, from the Strand		1 „ 19
Fleet Street, opposite Salisbury Court		1 „ 42½
Ludgate Hill, ending at St. Paul's Churchyard		1 „ 25
Holborn Hill, varies from	1 in 16½ to	1 „ 23
Skinner Street, varies from	1 in 24 to	1 „ 29

Messrs. Barnard and Geary published a plan, in 1836, for carrying a viaduct along the north side of Holborn Hill, between Hatton Garden and the upper end of Snow Hill, removing the greater portion of the houses between those points. The estimate of the expense was £350,000.

In the Second Report of the Metropolitan Improvements Committee for 1838 appeared a plan by Mr. Pocock, consisting of a viaduct on the south side of the hill, between St. Andrew's Court and Sea-coal Lane.

Mr. Galloway's plan, in 1841, was to erect in the centre of the present line of road a viaduct upon iron arches, between Hatton Garden and the Saracen's Head Inn; this viaduct was to be 30 feet wide, and used for horses and carriages only, leaving the street below as at present, only widening it where requisite.

Mr. Moon's plan, in 1841, was nearly similar to Mr. Turner's, only insisting upon a greater width of road.

Several propositions were also made for forming a new street either on the north or south side of Holborn Hill; among them are mentioned the following plans:—

Mr. Davey's, in 1833, which was to commence at Fox Court, in Gray's Inn Lane, cross Saffron Hill, and proceed, in the form of a crescent, to meet Skinner Street above Snow Hill.

Mr. Whishaw's plan, in 1835, was to build a viaduct, commencing at the end of Fetter Lane, to the north of New Street Square, thence across Farringdon Market, which he proposed to render more convenient and airy, and to terminate at the top of the Old Bailey, the roadway throughout being perfectly level.

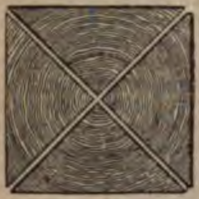
Mr. Ross's plan resembled Mr. Whishaw's, but was less comprehensive, and avoided Farringdon Market, the viaduct being still nearly level.

These latter plans were laid out with a view of avoiding the existing thoroughfare, and the valuable property on Holborn Hill and Skinner Street. The plans were collected by the author for the purpose of showing their comparative merit and originality, and (as far as he was able) the dates. The communication was illustrated by a series of drawings and lithographs of almost all the schemes, with prospectuses of nearly all for reference.

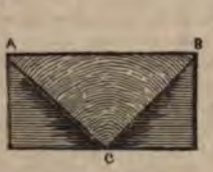
March 1.—The President in the Chair.

"*Description of the Permanent Way of the South-eastern Railway.*" By John Pope, Grad. Inst. C. E.

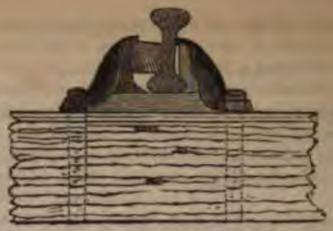
This communication commences with a general description of the slopes of the cuttings and the embankments of the line, and explains the mode of ballasting and the quality of the materials employed. On either side of the bank of ballast, and below the level of its bed, there is an open drain, 3 feet in width, extending throughout the line, which ensures perfect drainage from beneath the sleepers. The different works connected with the laying of the rails are then successively noticed. The sleepers are placed transversely, and differ in shape from any hitherto employed. They are of Baltic fir, and are formed by a square balk being diagonally divided so as to cut out four triangular sleepers, which are laid with the right angle C downwards, which form (A B C) has as much bearing surface as one of twice the cubic content cut out as a half balk in the usual manner. The advantages arising from this form in the economy of timber, the facility of packing, and the improved drainage of the ballast in contact with the sleepers, are pointed out, and the apparent disadvantage of the tendency to act as a wedge, is combated by showing that the inclination of a right angle exceeds the limits within which he principle of the wedge obtains. The chairs are of a peculiar form, designed by the engineer to combine lightness with strength; they are cast on a plan invented and patented by Messrs. Ransome and May, of Ipswich, whereby the inward inclination of the rails, instead of being made to depend merely upon the rail layers (as is usually the case), is effected entirely by the shape of the cavities of the chairs, which are all cast with peculiar accuracy. The uniformity of inclination attained by this improvement greatly diminishes the lateral motion of the carriages, observed on almost all other lines of railway. The chairs are placed horizontally on the sleepers, and are fastened down with trenails of oak compressed by the patent process of Messrs. Ransome and May.* The wedges employed to secure the rails in the chairs are similarly compressed. Details are then given of the rails, which are parallel, with their upper and lower tables of equal breadth; of the amount of compression of the wedges and trenails, their dimensions, shapes, &c.



Square balk divided to form four sleepers.



Triangular sleeper A, B, C, contrasted with a half balk.



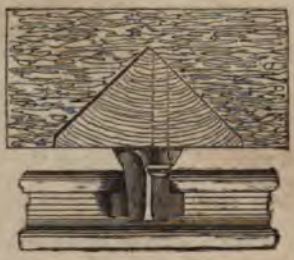
Elevation of Chair, showing the inclination of the Rail.

The author concludes by stating, upon the authority of Mr. Barlow, the resident engineer of that part of the line, that the passage of 70,000 tons of ballast over several miles of the "permanent way" already completed, has not rendered the slightest repair necessary, although the weather has been very unfavourable.

The paper is accompanied by a drawing showing the construction of the permanent way, and it was illustrated by the exhibition of a pair of sleepers with two pieces of the rails placed in the chairs, which were fixed down with the compressed trenails, complete as on the railway; all the tools employed in laying the permanent line; and specimens of teak, oak, mahogany, hornbeam, walnut, and other timber, compressed and cut so as to show the subsequent form of the sap vessels.

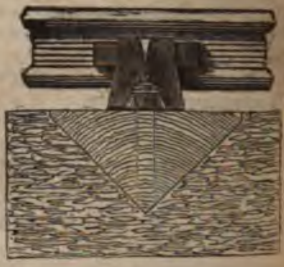
Joint Chair.

End view.

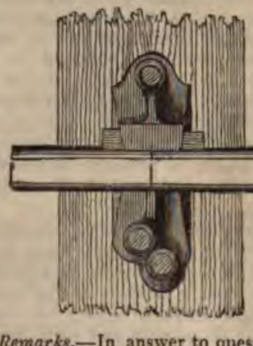


Intermediate Chair.

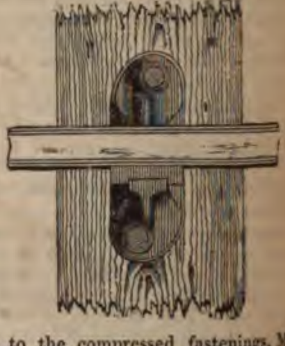
End view.



Plan.



Plan



Remarks.—In answer to questions as to the compressed fastenings, Mr. May explained that the peculiarity of the system consisted in the fibre of the timber being compressed equally from the circumference to the centre. The pieces of wood for the wedges were cut out with parallel sides and forced by hydraulic presses into tapering moulds; whilst in those moulds they were subjected to the action of heat applied through the medium of low pressure steam, and after being allowed to cool, they were forced out of the moulds, and so long as they were kept dry would retain their form; but as the operation simply contracted the dimensions of the sap vessels without crushing the fibre, the power of capillary attraction was not destroyed, and when driven into the chair and exposed to moisture, they swelled so as to remain perfectly tight. There was this difference between wedges so compressed and all others; that a true wedge was formed from a piece of wood cut parallel on all sides, whilst all former modes that he was acquainted with produced, not wedges, but parallel pieces.

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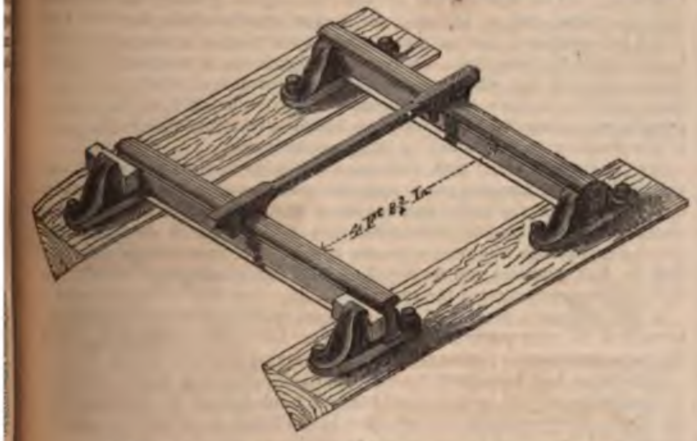
* Minutes of Proceedings, 1840, p. 84.

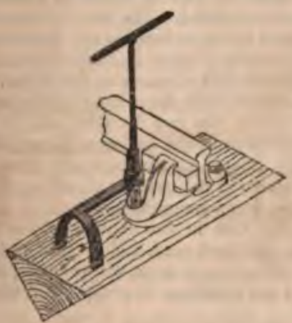
The diminution of the bulk of the trenails, by the process, is from 100 to 63, and of the wedges from 100 to 80. It is found that the wood does not swell until it is placed in a damp situation, as in the sleepers. Even the most solid woods, such as African teak, can be compressed without sustaining injury. Perfectly seasoned timber will not shrink after compression, but green wood will shrink after the process. One of the principal advantages of the compressed trenails is the firmness with which they hold into the sleeper. Around the iron spikes generally used, a sheath of rust is formed by the damp sleeper; the shaking of the carriages tends to draw them upwards, and the elasticity of the fibre around the hole in the sleeper being impaired, it is of no use to drive them down again in the same place, and the chairs eventually become loose.

The mode of casting the chairs was described to be by placing an iron plate on each side of the pattern, ramming them up in sand, and using an iron core, which being sustained in its position by a projecting tongue falling into a groove in the side plates, preserves an uniform inclination of the rail in the chairs. Extraordinary precision is thus obtained, and only about 2 per cent. of waste-castings are made, although they are subjected to a rigid test, for if the bearing points allow the rail to vary $\frac{1}{16}$ of an inch from the required inclination, they are broken up. The iron cores do not unduly chill the metal, and the average strength is retained. The iron used is chiefly "Welsh Cold Blast."

Mr. Cubitt's object has been to lay a railway entirely upon transverse sleepers, of such a form as would expose the largest amount of bearing surface for the least portion of timber; that the bulk of the ballast should be beneath the bottom of the sleeper, where alone it is useful; to use only the best foreign timber; to have the rails rolled uniformly and sufficiently heavy; the chairs simple in form, possessing great regularity, and giving the inward inclination to the rail within the chairs, instead of depending upon the rail-layer doing it in fixing them; and that the fastenings should be simple, but firm, and not liable to breakage, or to be detached by the passage of the carriages.



Rails, Chairs, and Sleepers, with the "Cramp Gauge" fixed.



Guide Tube and Auger.

With these views he had directed four sleepers to be cut diagonally out of each square log of foreign timber, giving about 2½ cubic feet to each sleeper; to place them with the right angle downwards, so that the ballast could always be consolidated by ramming, without lifting the sleeper, or digging around it, as with square, or other formed sleepers; two places are planed to receive the chairs, and one fastening hole bored in each sleeper; they are then kyanized in close tanks, completely filled with the prepared solution, under a pressure of 80 lbs. per square inch. When placed upon the ballast, the joint chairs are first put down 15 feet apart, and the intermediate chairs loosely placed 3 feet apart; "cramp gauges," embracing the inside and outside of the rails, are then fixed between each pair of sleepers, and the wedges along one side driven up—one trenail being driven in each chair, the hole for which is previously bored in the sleeper by a gauge, to insure an equal projection on each side of the rail. A "guide tube" of an internal diameter to fit the spiral auger for boring the trenail holes, with the external lip tapered to correspond with the hole in the chair for the head of the trenail, is then used, and by its agency the holes are pierced with great accuracy, concentric with the hole in the chair, at the same time protecting the tool from being injured by the cast iron. The intermediate chairs are then fixed in the same manner, and the operations are repeated for the opposite rails; the ballast is then consolidated by ramming. It is found that the work proceeds very rapidly; the ballast supports the sleepers throughout, and has no tendency to fall away from them; the water drains away freely, and hitherto the passage of the ballast wagons over that portion of the line which is laid (although they are without springs), has been productive of benefit rather than injury.

The inclination of the rail being given in the chair had insured such accuracy, that after one day's traffic over it, the surface of the rails is rubbed equally throughout, and not alternately on either side, as is so commonly the case.

Mr. Cubitt did not claim the invention of the angular-formed sleeper, as Mr. Reynolds had used it before for his longitudinal bearing rails, but he believed that transverse sleepers of that form had not been previously laid down; nor did he claim the compressed wedges and trenails, or the peculiar mode of casting the chairs: the merit of these was entirely due to Messrs. Ransome and May, who had entered completely into his views and wishes, and executed them with extreme intelligence.

In answer to questions from the President, Mr. May replied that it had been an object to gain in the trenails and wedges the greatest amount of strength with diminished bulk, and also to cut away as little of the sleeper as possible in boring the holes; he had, therefore, introduced this method of compressing them, with a view also, that in swelling from the damp they should fix themselves tight into the soft timber sleeper, and hold the chair fast down.

He hoped to extend the use of compressed trenails to ship-building, for which they were eminently adapted; if they were used, smaller holes would be bored in the timbers, and they would hold tighter than the trenails now used, which require to have the points split and wedged up, and the heads also divided and caulked to prevent leakage through the open sap vessels of the wood.

The President remarked that on the Hull and Selby Railway, the chairs were fastened to the kyanized timber sleepers by uncompressed wooden trenails.

Mr. Cubitt was not aware of that fact; he had always found that uncompressed wedges and trenails would not hold tight. Some of the compressed trenails had been wetted by accident, and could not be afterwards driven into the holes in the chairs; they nearly resumed their original size, and then showed the marks of the turning tool upon their surfaces. In answer to a question from Mr. Parkes as to the comparative expense of laying the line, it was rather in favour of the system he had adopted, although the prices paid for the items separately, were higher than usual, but the saving in labour, and the almost total absence of waste of materials, gave the economy.

He then quoted a few of the prices paid; sleepers 6*s*. 6*d*. each (ready to lay down, including kyanizing); chairs 9*l*. per ton, free from faults in casting, the contractors for them replacing all that were broken in laying the line. Each joint chair, with three trenails and one wedge, 2*s*. 10*d*. Intermediate chairs, with two trenails and one wedge, 2*s*. 1*d*. each. The labour for laying the line was from 2*s*. to 3*s*. per yard running; the cost of fixing the sleepers, laying the rails, and ballasting complete, was from £1500 to £2000 per mile, including all expences.

Mr. Macneill fully concurred in the importance of providing for clear drainage from the sleepers; and in the advantage presented by the angular form for ramming the ballast. The transverse sleepers, with such rails as had been used on the South-Eastern Railway, were preferable to a continuous bearing, as they would prevent the gauge from widening, and preserve an uniform regularity of surface, which would tend materially to diminish the oscillating motion so common on railways, and which was so destructive to the engine and the carriages; altogether this railway appeared to be the most perfect he had hitherto seen.

He was using, on the Dublin and Drogheda Railway, chairs of somewhat similar construction, with uncompressed wooden wedges and fastenings; they were very roughly cast in Scotland, with hot-blast iron, and the breakage was very great; they, however, cost less than 5*l*. per ton. He believed that chairs such as were cast by Ransome and May would be cheaper at 9*l*. per ton. The uncompressed trenails were found in many instances to become loose. In ballasting the railway, as stone was cheap, the whole surface of the line was pitched transversely with thin stones, and then a good bed of broken stone used for ballast, in the same manner as Mr. Telford had proceeded with the Holyhead Road.

Mr. William Cubitt had compressed a considerable quantity of wood wedges, by forcing them singly, by the blow of a piston, through a taper steel mould; on leaving the mould they had attained their ultimate state of compression, and they were some time before they reassumed their original bulk, but he conceived that Mr. May's plan, by which they were dried in a compressed state, enabled them to retain their form longer. He considered the system of preparation, and of laying the road, to be the most perfect hitherto executed.

Some years since, Mr. Horne had made a series of experiments on the form of timber beams, which presented the greatest amount of strength with the least quantity of timber; he found that a triangular beam placed with the base upwards was one-third stronger than any other form.

Mr. Colthurst inquired whether the trenails and wedges had been found to have lost strength by compressing. He imagined that they would not bear a transverse strain so well as before compression.

Mr. May replied that no experiments had been tried as to the relative transverse strength of timber before and after compression.

Mr. S. Seaward thought it was probable the timber did suffer somewhat from compression, but that did not militate against the system, as there must necessarily be an original excess of strength in the trenails, so that no inconvenience could result from the process.

The President observed that although uncompressed trenails do draw out of the stone blocks, they hold fast in wood sleepers. The round trenails used to fasten the chairs to the sleepers on the Hull and Selby Railway, were of a proper size to fit the hole in the chair, and at the end a square head was left, which held the chair down.

Mr. Cubitt had frequently seen trenails or plugs driven into stone blocks to receive the iron spikes which fastened down tho chairs; he believed they had also been used for driving through the chairs into the blocks, but he was not aware that they had been used in wood sleepers until he employed them no the South-Eastern Railway.

In answer to a question from the President, Mr. Lynde explained, that upon the Hull and Selby Railway, trenails were certainly used in conjunction with wooden sleepers, a portion of them were uncompressed, but the greater part were compressed like the wedges; the latter were supplied by Mr. William Cubitt.

Mr. William Cubitt only supplied the wedges, they were compressed as he had previously explained; he believed that the trenails and wedges generally used upon the London and Birmingham, and other railways, were compressed by being driven through steel rings, by heavy mallets, or by a press; they were most frequently used in the stone blocks to receive the iron spikes.

March 8.—The President in the Chair.

"*Description of the Tanks for Kyanizing the Timber for the permanent way of the Hull and Selby Railway.*" By John Timperley.

Upon the recommendation of Messrs. Walker and Burges, the Engineers, it was determined that the sleepers of this railway should be kyanized in close vessels, using exhaustion and pressure, instead of in the open tanks usually employed. The present communication, which includes a description of the kyanizing vessels, and an account of the various circumstances connected with the operation, commences by describing the apparatus, as shown by the accompanying drawing, to consist of two tanks, a reservoir, two force pumps, and a double air pump. The tanks are cylindrical, with flat ends, and are made of wrought iron plates, nearly half an inch in thickness; they are 70 ft. in length, and 6 ft. in diameter: at each extremity is a cast iron door, flat on the outside, and concave on the inner side, provided with balance weights for raising and lowering it. Each end is strengthened by five parallel cast iron girders, whose extremities are held by wrought iron straps rivetted on to the circumference of the tanks. Notwithstanding the great strength of these girders, several were broken by the pressure applied during the process. The vessels are lined with felt, upon which is laid a covering of close jointed fir battens, fastened with copper rivets; this precaution is necessary to prevent the mutual deterioration which would arise from the contact of the iron and corrosive sublimate. There was originally only one brass force pump, 2 in. diameter, and 6 in. stroke; this being found insufficient, another was added of 4 in. diameter, and henceforward a pressure of 100 lb. per square inch was easily obtained. The air pump is 10 in. diameter, and 15 in. stroke. Its construction is of the ordinary kind. The author gives in an appendix to the paper a minute description of the various parts of the apparatus, with the details of their dimensions and weight. The process is simple and rapid; the corrosive sublimate is first mixed with warm water in a trough, in the proportion of 1 lb. of the former to 2 gallons of the latter; the clear solution is then poured off into the reservoir, where water is added till it is diluted to the proper point, which may be ascertained by an hydrometer: a more perfect test is the action of the solution upon silver, which it turns brown at the requisite degree of saturation. The operations of exhaustion and pressure employ eight men for five hours, the whole process occupying about seven hours, during which time from 17 to 20 loads are kyanized in each tank. It is desirable that the timber should remain stacked for two or three weeks after kyanizing before it is used. It was found that about ¾ lb. of corrosive sublimate sufficed to prepare one load (50 cubic feet) of timber. About 337,000 cubic feet of timber were kyanized, the average expense of which, including part of the first cost of the tanks, was about 5*d.* per cubic foot. The timber was tested after the process, and it was found that the solution had penetrated to the heart of the logs.

The paper contains some interesting tables exhibiting the quantity of solution taken up by different kinds of wood with and without exhaustion; from these it appears that the saturation per cubic foot in the latter case did not exceed 2·25 lb. with specimens of Dantzic timber, whereas it ranged between 12·24 lb. and 15.25 lb. with pieces of home-grown wood. The author observes that this striking difference may be partly due to the greater compactness of the foreign timber. Appended to this communication is a correspondence between Mr. J. G. Lynde and Mr. James Simpson relative to the best tests of the presence of corrosive sublimate, accompanied by letters from Mr. Colthurst and Dr. Reid; the former of these describes the process of kyanizing adopted on the Great Western Railway, and the latter suggests the three following tests:—1st, dilute hydro-sulphuret of ammonia; 2nd, a strong solution of potassa; dilute nitric acid and proto-muriate of tin, also gold-leaf with this solution; and 3rd, iodide of potassium. Directions are given for the application of these tests.

Mr. Lynde also mentions the use of a solution of nitric acid, and by the application of hydriodate of potash detecting the presence of mercury in a specimen taken from the heart of a log of timber 10 in. by 5 in., and 9 ft. long. He also details appearances of the destructive action of the corrosive sublimate upon the iron-work with which it came into contact, which would be prejudicial to the use of iron bolts in kyanized sleepers.

A drawing explanatory of the whole apparatus accompanied the communication.

Remarks.—In answer to questions relative to the process of exhausting the air from the receiver in which the bank-note paper was wetted at the Banks of England and Ireland previously to being printed, Mr. Oldham stated that as an experiment a packet of 1000 sheets of paper had remained a whole day in water without being wetted through: whereas by exhausting the air from the vessel containing them to a partial vacuum of 22 inches of the barometer, and admitting water, they had been perfectly saturated in five minutes; the edges of the paper in simple immersion would rot away before the mass was saturated; by the exhausting process 5,000 sheets of bank-note paper would absorb 16 lb. of water.

Mr. Simpson conceived that exhaustion would facilitate the process of kyanizing; but he believed that if time was allowed, pressure would accomplish the same end as perfectly, for he had observed that pieces of wood which had remained four or five days in a water-main under pressure had become perfectly saturated. Captain Scoresby, in his account of the whale-fishery, remarks that when a whale carries a boat down it rarely rises again' most probably because the fish plunges to such a depth that the extreme pressure water-logs the boat: instances had been known of the specific gravity of the planking being doubled by being carried down.

Mr. Newton remarked that immersion of timber in close tanks had been practised by Mr. Langton many years since for bending timber; a boiling fluid was used in the tanks, and the wood was subjected to heat for a considerable period. He had understood that Mr. Newmarch of Cheltenham was the first person who used corrosive sublimate for preserving timber, and that he had prepared and employed considerable quantities of wood. Mr. Kyan subsequently revived the system.

In Mr. Oldham's process of wetting paper, pressure was not requisite, on account of its open texture. About the year 1819, Mr. Oldham had tried the same process with perfect success for preserving meat.

Exhaustion had been tried by Mr. Harris for cleansing wool. The cops of wool were put into an exhausted receiver, a solution of an alkali was then admitted; after remaining a short time in the liquid, a sufficient quantity of diluted acid was added to neutralize the alkali, and the wool was washed out in clean water. The process succeeded perfectly, but was too expensive.

Mr. Palmer had employed the kyanizing process for large pieces of timber, for the ribs of lock gates, but had no means of ascertaining the depth to which the mercury had penetrated. The use of corrosive sublimate was first suggested by Sir H. Davy in his lectures at the Royal Institution, as a means of destroying the vegetating process in timber by the combination of the chlorine in the former with the albumen of the latter. Mr. Palmer much doubted whether the means used for exhausting the capillary tubes effected the object, unless the timber was in a dry state, and he considered it equally doubtful whether the solution could be forced to any considerable depth by compression, especially if any moisture actually filled the capillary tubes. The application of pressure in the process of salting meat suggested by Mr. Perkins many years ago, was a complete failure.

Mr. Simpson observed that in the experiments of Messrs. Donkin and Bramah pressure alone had been used, and it could easily be understood that owing to the cellular formation of meat, the pressure, instead of forcing the salt through it, caused the substance to collapse and the brine was prevented from penetrating.

Mr. Braithwaite explained that in Payne and Elmore's process, although pressure had been found indispensable, the meat was more perfectly prepared when exhaustion was also employed, therefore both were now combined.

Mr. May reverted to the subject of kyanizing timber; he believed that exhausting the air from the tanks previously to the admission of the solution was a loss of time—the fluid should be admitted first, or at least while the exhaustion was proceeding; labour and time would thus be saved, and the air would be more completely expelled from the capillary tubes before pressure was applied. It was essential that the timber should be as far as possible deprived of its sap as well as dried: as either sap or moisture appeared to prevent the proper action of the corrosive sublimate.

Mr. Cubitt regretted that experiments had not been made on the same kinds of wood both with and without exhaustion. The experiments on small pieces of foreign (Memel and Dantzic) timber with 80 lb. to 100 lb. pressure without exhaustion, showed an increase of weight of from 1½ to 2 oz. in pieces of about $\frac{1}{40}$ part the size of a sleeper, and that result agreed very nearly with his practice with sleepers of Memel and Dantzic timber, when kyanized without exhaustion under a pressure of 80 lb. to the inch; sleepers

2¾ cubic feet, gaining from 3 lb. to 5 lb. in weight by the process. t had been given of experiments with sleepers of foreign fir timber, both exhaustion and pressure had been applied, but it appeared that ch fir sleepers weighing 100 lb. when kyanized under exhaustion and re of 100 lb. to the inch, gained 33 per cent. in weight, which was 3 gallons of water being forced into less than 3 cubic feet of timber; ght that this difference could not be all due to exhaustion, but that it pend greatly upon the quality of the wood, because under a pressure b. to the inch, the air contained in a tubular substance (such as fir would all be compressed into about $\frac{1}{8}$ of its natural bulk without exhaustion, so that the difference between 5 lb. and 30 lb. forced eeper, could not, he thought, be all due to exhaustion, but must upon other circumstances not explained in this paper.

'resident thought that the greater degree of absorption by the Scotch be accounted for by its open texture, whereas the foreign timber e compact and also contained more turpentine. It might also have tter than the Scotch fir, which he believed had been the case.

aylor observed that hitherto the attention of the meeting had been directed to mechanical action, but that the chemical combination of osive sublimate with the albumen of the wood, was the point most upon by Kyan; it was supposed to be similar to the operation of hides, in which the tannin of the bark combined with and saturated ıal gelatin, which would not otherwise be permeable by the fluid in was placed.

Oldfield suggested that if the timber when piled in the tank was d to the action of heat at 212°, the moisture contained in the capillary ould be expelled in the form of steam, and that on the admission of tion, the tubes would instantly be filled with it, because of the partial formed in them.

olthurst observed with regard to the tests for ascertaining the amount ation of the timber, that he had tried all those described by Mr. and had not been able to discover the presence of mercury in the any of the timbers prepared for the Great Western Railway; their ons were 6 in. by 12 in. Dr. Faraday had, he believed, detected it aid of the galvanic battery in the heart of a piece of timber 2 ft. after simple immersion in the solution for fourteen days.

loss had tried many experiments as to the most delicate tests for ning the depth to which the mercury had penetrated: the most satis- test was gold-leaf, as from its strong affinity for mercury, the presence atter was immediately detected. The mode of proceeding was to put res of the wood to be tested into a small test tube, mixed with a of dry carbonate of soda; then to place over, but not in contact with all piece of gold-leaf, and apply heat to the bottom of the tube. If rcury was present, in however small a quantity, the fumes would rise olour the gold-leaf.

W. Cubitt said that timber was at all times, more or less, charged with e: he had found deals, supposed to be dry, lose 10 per cent. of their from steam drying; it was evident that the presence of moisture in es of the wood must militate against the success of kyanizing by immersion, unless it was continued for a very long period. In close when exhaustion and pressure were resorted to, the moisture was of less importance; but still, if the sap was extracted, and the previously dried, the process of kyanizing would be more efficient.

S. Seaward adopted Mr. Palmer's position, as to the almost impossi- f forcing the solution through the capillary tubes of a long piece of the pressure being applied equally all over the surface: he believed sent method of kyanizing to be very imperfect, and alluded to a num- sleepers so prepared for the West India Dock warehouses having been discovered to be decayed.

Martin confirmed this account of the decay of the sleepers: fifty out nty were destroyed; they had been prepared by simple immersion, been down about five years. He had understood that some of the tanks in which the solution was kept at the Anti-Dry-Rot Company's re decayed.

C. May believed that the destruction of the tanks might have arisen e constant corrosive action of the mercury, and not from decay. The y vessels of timber filled with air and sap, under exhaustion the air expand and drive before it a considerable portion of the sap and e. In preparing the compressed trenails and wedges he used steam, nd that the pores were opened by it. He suggested that steam should n through the tanks until all the timber in them was raised to a cer- nperature, and then by opening the communication with the reservoir ution would rush in and fill up the vacuum.

Cowper believed that it was only necessary to bring the chlorine of rosive sublimate and the albumen of the timber into contact, when ntly dry, to insure the preservation of the wood. He had occasion to eriments with paper pulp, and was constantly annoyed by its decaying the addition of a small quantity of chlorine had preserved it good for ars, and he believed that it would continue unchanged.

ral Pasley confirmed the statement as to the increase of the specific of timber from long immersion at considerable depths. He had ll the timber, except the mainmast, in the Royal George, at a depth ut 90 ft., water-logged. The oak timber had increased on an average an 50 per cent. above its usual specific gravity.

F. Braithwaite remarked upon the doubt which appeared to exist among members as to the correctness of that part of Mr. Timperley's paper where a sleeper containing 3 cubic feet of timber was reported to have increased 30 lb. in weight. Mr. Braithwaite had made some experiments, the results of which showed that a piece of Memel timber containing 533 cubic inches, and weighing when dry 9 lb. became double its weight when subjected to a pressure of about 320 lb. per square inch without previous exhaustion; the machine which he used not being provided with an air pump. A smaller piece of American pine, containing 76 cubic inches, and weighing 1 lb. 7 oz. increased in weight to 3 lb. under a similar pressure. This, he contended, established the correctness of Mr. Timperley's Report. There appeared also to be a misconception as to the amount of corrosive sublimate employed: the paper states that ¾ lb. was the quantity used for each load of timber of 50 cubic feet. He promised to make some further experiments, and report them to a future meeting.

Mr. Bull had prepared considerable quantities of boards for the Calder and Hebble Navigation, by immersing them in the solution for two or three days, which was about double the period allowed by the patentees. He had some specimens of the boards, and in almost all of them there was an appearance of decay in various stages. An oak board 1 inch think, kyanized in 1839, had lain ever since upon the damp ground exposed to the air: the sap part was entirely decayed, but the heart remained sound; fungus was, however, growing upon it. Poplar boards, kyanized in 1838, 39, and 40, were all partially decayed; those which were not prepared, and had been exposed in the same situation for the same period, showed, however, more symptoms of decay. In preparing the timber he had always followed the instructions of the patentees, and had tested the strength of the solution with the hydrometer, but had mixed up fresh solution even more frequently than was supposed to be required. On dismantling one of the tanks for holding the solution, he found the iron-work partially destroyed and entirely covered with globules of mercury.

Mr. Thompson explained that the hydrometer was not a correct testing instrument if any vegetable matter was present in the solution; that the tanks on the premises of the Anti-Dry-Rot Company were necessarily made of unprepared timber; that the bi-chloride of mercury in solution would penetrate any length of timber, if the extremities of the sap vessels were exposed to its action, but that it would not penetrate laterally without pressure; it was not, therefore, surprising that a water-tight tank of unprepared wood should decay on the outside, even if filled with the solution. With regard to the strength of the solution, at first it was believed that 1 lb. of corrosive sublimate to 20 gallons of water was sufficiently strong, and much timber had been so prepared, but experience had since proved that the strength of the mixture should not be less than 1 lb. to 15 gallons, and he had never found any well-authenticated instance of timber decaying when it had been properly prepared at that strength: as much as 1 in 9 was not unfrequently used. In a cubic foot of wood prepared under a pressure of 70 lb. per square inch, mercury had been found by the galvanic battery to have penetrated to the heart.

Mr. Horne mentioned that a new process had been invented by Mr. Payne for rendering timber proof against dry or wet rot, and the ravages of insects; for increasing its durability and rendering it incapable of combustion. The mode of proceeding was to impregnate the wood with metallic oxides, alkalies, or earths, as might be required, and to decompose them in the interior of the wood, forming new and insoluble compounds.

Mr. Taylor drew the attention of the meeting to a Memoir on the Preservation of Woods which had been read before the French Academy of Sciences by Dr. Boucherie. It was argued, that all the changes in wood were attributable to the soluble parts they contain, which cause fermentation and subsequent decay, or serve as food for the worms that so rapidly penetrate even the hardest woods. By analysis it was found that sound timbers contained from three to seven per cent. of soluble matter, and the decayed and worm-eaten, rarely more than one or two per cent.; since therefore the soluble matters of the wood were the causes of the changes it underwent, it became necessary for its preservation, either to abstract these soluble parts, or to render them insoluble, by introducing substances which should prevent their fermenting. This might be done by many of the metallic salts or earthy chlorides. Pyrolignite of iron was particularly recommended as being a very effective substance and cheaper than corrosive sublimate. The process was, to immerse the end of a tree, immediately after it was felled, in the solution of metallic salt, when, the vital energies not having ceased, the fluid was absorbed throughout all the pores of the tree, by a process which is termed "aspiration." The fluid had been applied in bags, to the base of the trees when in a horizontal position, or to one of the branches, or by boring holes to the heart, a few branches and a tuft of leaves being always left at the top of the principal stem. It was necessary to apply the process speedily after felling the timber, as the vigour of the absorption was found to abate rapidly after the first day, and became scarcely perceptible about the tenth day, whilst in dead wood, or where there was any accidental interruption of the flow of the sap during growth, the "aspiration" entirely failed; resinous trees absorbed less of the fluid than any other. The ends proposed to be attained by this process were chiefly—preserving from dry-rot; increasing the hardness and the elasticity; preventing the usual changes of form or splitting; reducing the inflammability and giving various colours and odours, according to the nature of the fluid absorbed.

Mr. Bethell remarked that the process described in Dr. Boucherie's pamphlet was identical with that patented by him July 11th 1838, two years before Dr. Boucherie's was mentioned in Paris, which was in June 1840. The specification filed by Mr. Bethell stated "that trees just cut down may be rapidly impregnated with the solution of the first class, hereafter mentioned (among which is included the pyrolignite of iron) by merely placing the butt ends in tanks containing the solution, which will circulate with the sap throughout the whole tree; or it may be done by means of bags made of waterproof cloth affixed to the butt ends of the trees and then filled with the liquid."—Mr. Bethell found that some solutions were taken up more rapidly by the sap and circulated with it more freely than others, and the pyrolignite of iron seemed to answer best; he had not hitherto introduced the process in England, because it was much more expensive than the oil of tar, the pyrolignite costing from 6*d.* to 9*d.* per gallon, and the oil being delivered at 3*d.* per gallon.—Mr. Bethell had used similar tanks to those described in Mr. Timperley's paper for preparing wood with the oil of tar, but as the oil is very penetrating, previous exhaustion of the air had been found unnecessary, the hydrostatic power being sufficient. The mode of working the tanks was to charge them with timber, close them and fill them with the oil; a hydrostatic pressure of from 100 lbs. to 150 lbs. to the inch was applied by means of the force-pumps, and kept up for about six hours; this was sufficient to cause the wood to absorb from 35 to 40 gallons per load. By this means a charge of timber was easily prepared daily, the cost being about 14*s.* per load. This was the plan pursued at Manchester for the Manchester and Birmingham Railway, by Mr. Buck (upon the recommendation of Mr. Robert Stephenson), and also at Bristol and Bridgewater by Mr. Brunel. Mr. Bethell preferred egg-shaped ends for the tanks as they resist the pressure better than flat ends. The solution of corrosive sublimate used at Hull appeared to Mr. Bethell to be very weak. The advice given by Sir Humphrey Davy to the Admiralty many years since was, to use 1 lb. of corrosive sublimate dissolved in 4 gallons of water, and Mr. Kyan in the specification of his patent states that strength, but according to the paper it appeared that 45 gallons of water were used to 1 lb. of the salt instead of 4 lbs.

In answer to a question from Mr. Pellatt, Mr. Bethell stated that his experiments on the use of silicate of potash or soluble glass for rendering wood uninflammable were not yet concluded; he had proved its efficacy in this point—that as soon as the prepared timber was heated, the glass melted and formed a filmy covering over the surface, which protected it from the oxygen of the air and prevented its catching fire. The silicate also hardened the wood and rendered it more durable. This process was included in his patent of July 11, 1838.

Professor Brande could add but little to what had been said on the subject, but he mentioned a curious appearance in a beech tree in Sir John Sebright's park in Hertfordshire, which, on being cut down, was found perfectly black all up the heart. On examination, it was discovered that the tree had grown upon a mass of iron scoriæ from an ancient furnace, and the wood had absorbed the salt of iron exactly in the same manner as had been described in the new process. The degrees of absorption of various solutions by different woods demanded careful experiments, as some curious results would be obtained; it was a question whether a solution of corrosive sublimate in turpentine, or in oil of coal tar would not be advantageous, as both substances were so readily absorbed by timber.

Mr. Defries explained the construction and action of his Dry Gas Meter, which was exhibited before it was fixed in the Gallery of the Institution.

The instrument consists of a hexagonal case with three solid partitions radiating from the centre to the circumference, across each division thus formed is a flexible partition, to the centre of which is fixed a plate, connected by a lever and shafts with the valves on the top of the case; by means of a combination of levers and cranks with a worm and screw a circular motion is given to dials indicating the quantity of gas which passes through the machine.

The gas, on entering the upper chamber, passes through the valve into the first division and distends the flexible partition until the lever is carried to a certain point, when by means of the connecting shaft the inlet valve is closed, the outlet valve is opened, and the second division commences its action, which is continued by the third, thus producing an equal flow of gas, and an uniform motion is given to the counter-dials, which necessarily indicate the number of times the divisions have been inflated and emptied, and thus measure the quantity which has passed through in a given time.

The instrument which was presented to the Institution, had its sides formed of glass in order to show the action of the machinery.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

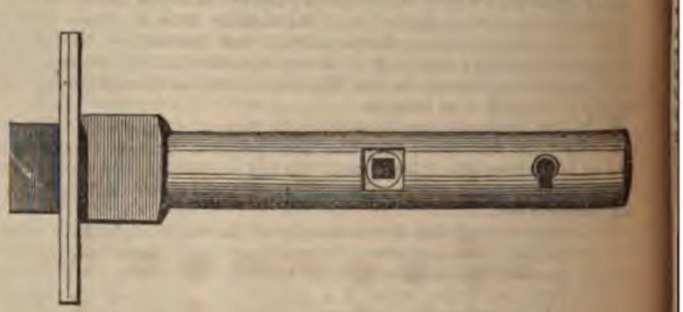
May 16.—T. L. DONALDSON, Esq., V. P., in the chair.

A paper was read by Prof. Willis, "*On Gothic Tracery, exemplified by the Windows of the Chapter House at Salisbury.*"

In the tracery of the Gothic style, four principles may be discerned, which will be found universal when the tracery is perfectly developed. 1st, Foliation, or the decoration of the compartments with those curves and points which have been denominated cusps; 2nd, Subordination, or the division of the design into certain leading compartments, which are marked by bolder lines of moulding than the secondary compartments inclosed within them; 3rd, Parallelism, with relation to the mouldings, or groups of mouldings, which form the common divisions between adjoining compartments; 4th, Symmetry, or a similarity between the opposite sides of those divisions. In complete tracery, where all these four principles are carried out, the compartments are compactly fitted together, and the mouldings mitre wherever they meet. In the tracery of the early Gothic, these principles are only partially developed; thus, in the triforium of Salisbury Cathedral, we find foliation and subordination, but neither parallelism nor symmetry. A segmental arch incloses two pointed arches, and each pointed arch two others. Here we have subordination, and foliation appears in the arches last mentioned, and in the openings in the spandrils; but there is no parallelism, the forms of the open compartments being without reference to each other, and having blank spaces without tracery between; and symmetry is wanting, since the mouldings of the secondary and tertiary compartments are treated differently in different parts of the composition. All this is characteristic of early Gothic tracery, and may be seen at Ely, Gloucester, and other edifices in the same style. The tracery of the cloister and chapter-house at Salisbury, the details of which Prof. Willis illustrated by several elaborate drawings, is remarkable as forming a link between the early and late tracery, going a step in advance of the former, without being complete. Parallelism is added to the two first principles, but symmetry is still wanting, each corresponding set of compartments being treated differently on each side of the dividing mouldings. There is, therefore, very little mitring, although the compartments fit together perfectly, without any blanks between them, as in the triforium of the church. So great an independence in the mouldings, where the principles of tracery are otherwise so perfectly developed, is very singular. The same observations apply both to the inside and outside of the windows, although these also differ from each other.

Another characteristic of early tracery is, that every compartment, principal or subordinate, has its separate hood-mould, as in the triforium already cited; but in the cloister and chapter-house this is discontinued, and its place supplied by a large double ogee. The Professor then made some remarks on the necessity of studying the true forms of the mouldings in Gothic architecture. The ancient details will be found, on examination, to be drawn with astonishing spirit and freedom of hand, whereas it is too much the modern practice to draw all the curves with the compasses—a method totally destructive of their real character, especially in the early Gothic style. In conclusion, he exhibited an instrument by which such curves may be traced with precision. It consists of a *stylus*, bent at one end in such a manner, that while by turning it in different directions, it enters into the deepest hollows, the point is always in one axis, at the extremity of which a pencil traces the lines followed by the point. This portion of the instrument was invented and exhibited at the Institute by Prof. Willis some time since, and he has now added to it a parallel movement attached to a drawing-board: by this contrivance, the most intricate combinations of mouldings may be traced with great facility and the most perfect accuracy.

GERISH'S PATENT CYLINDRICAL MORTICE LOCK.



THIS lock, as shown in the annexed engraving, which is drawn to half the real size, merits general attention from the simplicity of construction, and the easy manner in which it can be fixed to doors, the portability of the key, and the security it affords. It will be seen that by merely boring a hole with an auger in the door, it is at once fixed, thereby saving considerable time in cutting a large mortice which frequently injures the door. There is only one bolt, for the purpose of locking it; there is a contrivance at the back or end of the bolt; by turning the key a lever or tumbler is let down which prevents the latch bolt being turned back. The mortice lock before us, strong enough for a room door, is 6 inches long and ¾ of an inch in diameter.

THE NEW PALACE OF MOORSHEDABAD, IN BENGAL,

Erected for His Highness Nuwaub Nazim, by Major General M'Leod.

Sir—Under this head, in the number for the present month of your very valuable Journal, honourable mention is made of "Two very splendid water-colour drawings by Mr. John Edward Jones, being perspective views of a Palace built in India for one of the subsidiary princes." As the mistake into which you have most unaccountably fallen in the above notice is calculated to do me some injury both in my professional and private capacity, you will excuse me for troubling you with a few lines on the subject.

The drawings adverted to were sent to the Institution of Civil Engineers from the office of Mr. J. E. Jones by whom I was engaged to prepare them, but not one line was drawn nor one brush of colour applied by Mr. Jones to either. The work, whatever it may be, was wholly mine—drawn from plans supplied by and directions and explanations given to me, from time to time, by General M'Leod personally, who has permitted me to refer to him for the accuracy of this statement.

As I was fully prepared to bear any blame or criticism to which these exhibitions before such competent judges might have subjected me, I shall not, I presume, be considered unreasonable in claiming any credit which these productions of my pencil may be deemed worthy.

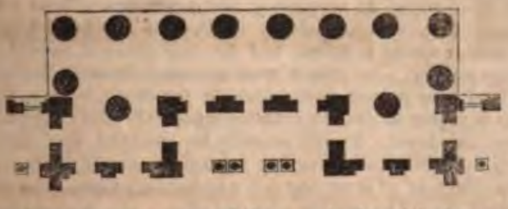
The following extracts from a letter of a much respected and valued friend in Manchester will, however, show that I have no choice in the matter, but that I am imperatively called upon in support of my own character to make this statement—"In this month's Civil Engineer's Journal, I find an engraving of General M'Leod's palace, and great credit given to a Mr. Somebody for having made the drawings. Is this a mistake, or have you misled me?" This leads me further to observe, that I have now in the Exhibition of the Royal Academy two other drawings (Nos. 1027 and 1050) from the same subject, and though not copies of those sent to "the Institution," they are composed and drawn from the same source. The two sets of drawings will be seen by many of the same individuals, and it might be imagined without some explanation, that I had been guilty of plagiarism, and had pirated both ideas and subjects from those first exhibited as the production of Mr. J. E. Jones. As this would stamp me with a character which I, in common with every honourable mind, despise and detest, I must beg of you to give insertion to this communication in your next number.

Rutland Cottage,
John Street, Hampstead,
May 9, 1842.

I am, Sir,
Your obedient servant,
J. W. Atkinson.

Sir—I have seen and have been much gratified by your notice of the Moorshedabad palace in your excellent Journal for this month, or rather that you have thought it worthy of a place there. Mr. Jones' draughtsman has, however, made one or two unfortunate mistakes in the drawings, which I should be very glad if you could oblige me by in any way bringing to the notice of those who look upon such matters with interest, in your next monthly publication.

In the first place, the scale for the elevation is just half what it should be, the whole space from 0 to 50 being divided into 50 instead of 100 feet. In the next place he has been guilty of an omission in the plan, which I dare say you will agree with me in considering in a great measure destructive of the beauty of the southern portico, by leaving out the two internal columns between the antæ of the recess, as shown in the annexed engraving; they being a principal feature in the composition, while the capitals of the pilasters or antæ are very clumsily represented.



There are also one or two errors of the press in the original report, which I ought to have marked before I sent it to you through Mr. Jones. In describing the circular room, p. 152, column 2, line 48, it mentions four large *covered* recesses instead of *coved* recesses, and at the same place the words "over which are long panels," ought to have been within brackets [ ], without which that which follows appears nonsense. There also appears the word *bricken-edge* instead of *brick-on-edge.*

229, Regent Street,
May 9, 1842.

I remain,
Yours very faithfully,
D. M'Leod.

TREWHITT'S APPARATUS FOR DISCONNECTING PADDLE WHEELS.

Sir—In a recent number of your Journal, I observed a drawing and description of Trewhitt's Patent Apparatus for disconnecting the paddle wheels of steam vessels from the engines.

This apparatus has been applied by Scott, Sinclair & Co. to the steam ship Phœnix, which they have just completed, and the result of the trials made with it is so satisfactory, I consider it due to the Patentee to state that for its simplicity, facility of operation, and absence of liability to derangement, it has not been surpassed by any invention yet introduced for that purpose.

The paddle wheels are connected to, or disconnected from the engines with a friction strap by a few blows of a sledge hammer on the end of a key, which is shown in your drawing; and the greatest proof of its superiority over every other mode is that the paddle wheels were connected and disconnected when the vessel was at full speed.

Your obedient servant,
James M. Scott.

Grenoch Foundry, May 21, 1842.

REVIEWS.

A Treatise on Land Surveying and Levelling. By Henry James Castle, D.P.S. London: Simpkin and Marshall, 1842.

Practical Geology. By Butler Williams, C.E., F.G.S. London: Parker, 1842.

Course of Civil Engineering, comprising Plane Trigonometry, Surveying and Levelling. By John Gregory, Esq., C.E. Dublin: Samuel J. Machen, 1842.

If all the books that have been written on the subject of surveying had in reality been what the authors professed, and what the public had a right to expect they should be, what a nation of surveyors would this have been! Surely no other profession in the world has ever been so blessed with the labours of industrious authors;—no other profession can boast of an amount of printed paper devoted to its especial use, which, had it been properly employed, would have sufficed to teach the art of surveying to every man, woman and child in the empire. But when we ask the question how many of these books have been worth the labour bestowed in writing them, or rather in copying and compiling them, how many have repaid the trouble of reading, and been worth the expense of buying—one general expression of indignant contempt for the stale and childish nonsense with which the majority of these books have been filled, flashes upon us from every side, an answer too correct for refutation, too bitter for ridicule.

The proof indeed that these books, in common with other means more likely to succeed, have failed entirely in that which the authors sought to accomplish, may be found in the fact that a large number of the provincial surveyors of this country are exceedingly incompetent to conduct even the process of common land measuring, on any thing like an extensive scale. The great survey which has been for some years in progress for the combined object of effecting the commutation of tithes, and the establishment of a new parochial assessment has tested in a remarkable degree the capacity of the local surveyors in all parts of the country. It would be interesting to know, with respect to each county of England and Wales, how many of its parishes or townships have been surveyed by men locally established, and how many have been done by surveyors from the sister isle, who have continued to swarm over to this country ever since the commencement of these surveys. It would probably be found that those counties where a great number of enclosure acts have been obtained within the last 50 years—those which have been the site of large engineering works, and particularly those which contain the vast tracts of land brought into cultivation by lowering the outfalls of the Ouse and the Nene, do possess at this time local surveyors who understand their business, and who would have been capable, had they been sufficiently numerous, to conduct the whole of the tithe and poor law surveys of this country. On the other hand, in those counties where there have been no waste lands or no open fields to enclose and to allot—where the development of manufacturing resources has not so extensively nor so rapidly called for the interchange and alienation of land—and where no new creation of the solid acres has required allotments, divisions and subdivisions to be made, it is quite natural to suppose that the art of surveying should have fallen off for mere want of practice on the part of its professors.

The deficiency of good surveyors in England was readily supplied from that large body whom, the Ordnance survey of Ireland had trained up in the style of practice, which was of all others the best adapted for the ordinary chain surveys of land. A great proportion of the parochial surveys throughout England and Wales has accordingly been executed by these men, and it is impossible to deny that their productions reflect great credit upon the school in which they were trained, and upon the system which they had been taught to practice.

We are not able to decide whether all the objects required by the New Poor Law Act, and by that for the Commutation of Tithes have been thus as satisfactorily accomplished as if the survey had been executed by the native surveyors, whose local knowledge, one might suppose, would in many respects have given them great advantages over a body of strangers. But however this may be, the surveyors of England have only to thank themselves for all the injury which many of them in no very measured terms impute to the immigration of their Irish brethren. It is quite certain that if the native surveyors in England had been competent themselves to execute these parochial surveys with the necessary degree of accuracy, the value of the surveyor's labour would not at this day have been reduced to the pitiful rates at which it is now performed. Competition, in its proper place and under certain necessary restrictions, is a very good and wholesome check upon arbitrary and extravagant charges, but there are circumstances connected with the competition to which these parochial surveys have given rise, which press with peculiar hardship upon the surveyors of this country.

Admitting the truth of these remarks, it would appear that the surveyors as a body have yet much to learn; and in so far the publication of books to teach them their business seems to be justified by the necessities of the case. The misfortune however is that books may be either useful or useless, and if the majority of surveying books have been of the latter class, it would have been better by far if they had never been given to the world. But in addition to the assistance which many professed surveyors might derive from useful practical works, the instruction of the rising generation claims particular attention. The establishment of numerous colleges and schools of civil engineering, and the appointment in these of professors of geodesy and land surveying, mark well the general importance attached to the education of the engineer in that part of his profession which relates to the measuring of land, and to the other operations necessary before the commencement of constructive works.

Notwithstanding the great number of books which profess to treat on surveying, there are few which comprise any thing like a course of instruction in field engineering; and it is to supply this deficiency that the professors of this art in several of the new colleges have prepared for the use of their pupils, treatises intended to guide and promote their studies. The three books mentioned at the head of this article proceed from three of these professors, the author of the first being the lecturer on practical surveying and levelling to King's College, London, while Mr. Williams is the professor of geodesy in the College for Civil Engineers, London, and Mr. Gregory is the resident director of the College for Civil Engineering, Mining, and Agriculture in Ireland.

It gives us great pleasure to be able to speak in terms of unqualified praise of Mr. Williams' book, which not only contains a mass of condensed and useful instruction on those branches of the subject which had been treated by former authors, but also presents several chapters of great practical value upon subjects which have hitherto been quite untouched. The chapter on hill drawing and that on surveying as applicable to the colonies are of this kind. The first is an admirable description of the system of normal contours adopted on the ordnance survey of Ireland, and on the French *cadastral* survey. It is scarcely possible to convey a clear idea of this system without quoting the entire chapter, but in its application to the representation on a plane surface of the natural irregularities of a country, it may be understood by conceiving a number of perfectly horizontal lines to be traced around a hill, and afterwards transferred to the paper on which the plan of the hill is represented. These lines are termed normal contours, and supposing the hill to be of a perfectly conical shape, they would appear on the plan as concentric circles, whilst in hills of other shapes, the irregularly projecting parts would be shown by outward flexures of the normal contours, and the irregularly retreating parts by inward flexures of the contours. The practice is to trace these horizontal lines at equal vertical distances so that the steepness of the slope at any particular point on the plan is indicated by the distance between the normal contours at that point.

"On the Irish survey, the plans with the normal contours traced upon them are afterwards placed in the hands of field-parties, whose duty consists in filling in the detail to produce physical relief, and give expression of form and character to the drawings." There is obviously no limit to the degree of fidelity and value which may be given to these representations. The contours for example may be traced at very small vertical equal distances by means of levelling a series of pickets in the same way as level stakes are fixed in railway and canal works, and as the horizontal distance between the contours may always be taken from the plan, and the vertical distance being constant is always known, it is obvious that a section exhibiting the levels of the country may be laid down in any direction from a plan distinguished by this method of representing its irregularities. We have thus merely glanced at this beautiful style of representation, but we must refer our readers to the work itself for a clear and well written description of the best method of executing it in the actual practice of surveying.

The chapter on surveying as applicable to the colonies will be highly interesting at this time when so many young men are looking forward to the employment of their abilities in this distant field.

It is proposed to divide the land into sections of 80 acres, comprised in rectangles, whose length is equal to twice their breadth, and of which there would of course be eight in a square mile. But as in all new countries the possession of water frontage is considered a great advantage, some contrivance is necessary to distribute this in an equitable manner, and to overcome the irregularity which would be introduced into the form of the allotments if those bordering on the rivers were made of equal size with the others. This contrivance appears admirably adapted to afford satisfaction to the purchasers of the sections, and to preserve uniformity and simplicity in the method of laying them out. It is impossible however to describe it without the aid of the diagrams which illustrate this part of the work. The author states that he is "indebted for the information embodied in this chapter, to the able report *on surveying as applicable to the colonies*, made by Captain Dawson, R.E. to the Secretary of State for the Colonies, in 1840." It were well if this gentlemanly habit of acknowledging the sources of information, which Mr. Williams has every where followed in his book, could by some means or other be made to possess more favour in the eyes of authors. There is one admirable feature also in Mr. Williams' book which we must not omit to notice, namely, that all the lumber about practical geometry and trigonometry with which most of the surveying books are half filled has been discarded, and he commences the book in a plain straight forward way, by showing how to survey with the chain. When youths are set to learn even the elementary parts of mathematics, such as geometry and trigonometry, it is not usual to put into their hands books on surveying for this purpose, and we have always been at a loss to understand for whose benefit—unless for that of the printer and the paper merchant—so great a quantity of elementary instruction in mathematics has preceded the introduction of the real subject of the work. In addition to the two chapters we have noticed, Mr. Williams' book contains excellent remarks and instruction on the following amongst other subjects—levelling with the mountain barometer—mining surveys—latitude and longitude—maritime surveying, the whole of which are treated in that masterly and original style which indicates a perfect command of the subject in all its branches.

Of the other two books before us we have little to say. A single glance suffices to show that they are not the productions of practical men. They abound in most of the faults from which Mr. Williams' book is free. Abundantly prefaced by preliminary matter which may be taken from any elementary course of mathematics, they have both scrupulously followed the practice of those venerable and ancient authors who wrote on surveying 100 years ago. Thus the pupil is first taught to survey one field by itself, then two fields together, and then a bolder spring is taken, and he may proceed to half a dozen or to a large survey. All this is mere nonsense, because the principle on which land is measured, particularly by the chain, is so perfectly simple that it is just as easy to practice upon 500 fields together as upon one, two, or three. It will scarcely be believed that the examples showing the method of surveying even these single fields are such as any schoolboy, or at least any lad who has had three days' instruction in the field, would be utterly ashamed of.

What will the practical surveyor say to such notes as this taken from the example of a field book by Mr. Castle, for a survey of fields near Maiden Lane. Line 578 ends at offset 98, at 908 on 1728. Line 579 ends at offset 23, at 820 on 1955. Line 734 ends at offset 21, at 483 on 968. We could scarcely believe, even on the actual evidence of our eyes, that the author meant these lines to terminate not in other lines but at loose points determined by offsets. There is however no doubt of the fact, because the plan showing the construction lines quite confirms it. To those of our readers who have ever paid any attention to the subject, no comment can be necessary on such a specimen of surveying as this.

Both the works are full of those old woodcuts which adorn the surveying books written by our ancestors, and they both contain the same ample variety of expedients for doing that which no one was ever puzzled to do, and probably will never be required to do if he should practice surveying for 100 years. To give an idea of the extent to which the most approved system of bookmaking has been followed by Mr. Gregory, we may state that out of the 300 pages which compose the book, the first 160 are filled with a treatise on logarithms and plane trigonometry, and with tables of logarithms and sines and tangents, which tables to the amount of 50 pages being duly set forth in the middle of the book, produce the agreeable effect of varying the monotony of the letter-press, at the same time that they serve to eke out the contents of the book to a very respectable bulk. This work of Mr. Gregory's is called a course of civil engineering, and this is the first volume of it. None of this relates to engineering, but one may anticipate, from the specimen before us, what a splendid contribution to engineering science the succeeding volumes will constitute.

Lecture on Fresco Painting. By Mr. HAYDON. London: H. Hooper, 1842.

AMONG the labourers in introducing fresco, Mr. Haydon has taken a prominent position, and we hope will do much good. We are pleased to see that he is no longer what he was, for though occasionally breaking out against "cocked hats," and the detestable Academy, his opposition is more tempered, and his exertions better directed. As a lecturer on the arts, he has done more than any man of the day in making them popular, his address is striking, his mode of treating his subject pleasing, his acquaintance with his subject extensive, and his teachings, if not always sound, erring only by aiming at an unattainable standard. As a public man, Mr. Haydon is now in the third act of his career; his first was that of the promising artist, his second that of the embittered, disappointed, and overweening opponent of the whole artistic community; in his third act, as a public teacher, he has given a popularity to art by lectures both in the metropolis and the provinces, which have not only led to the formation of many schools of design and classes for drawing, but have raised the character of the artist and the artisan. After exhibiting at the British Artists' Institution last year, and the Royal Academy this, and having seen that both now and on some former occasions, he could deliver an hour's discourse without vituperating the "cocked hats," we look upon him as an artist restored to the world, and we rejoice for him. He is now, we hope, about to do service to the public, and honour to himself, by promoting the national celebration of all the arts, which the Houses of Parliament will immortalize.

Mr. Haydon is one of the west countrymen who have given so many illustrious names to art, numbering two presidencies and the triumphs of Reynolds, Lawrence, Opie and Baily. He came up from Devonshire one of the most promising men of the day, and started with Wilkie, to whom he was equal in the delineation of nature, while he was then superior in having the choice of southern instead of northern features, and having higher artistic aspirations. Wilkie's subsequent career of honour, all know. A schoolboy quarrel with the Royal Academy, one of whose members is said to have exclaimed, on hearing of the arrival of Haydon's pictures for the exhibition, "Oh! Haydon's pictures to the coal-hole," made him the Timon of modern art. Hinc illæ lachrymæ. He had rivals and he had partisans, he ruled his small senate at Utica, and the class-book of human nature teaches us the result, the ruin of his social and artistic position, and the gradual narrowing of the circle of retainers, and the increase of that of foes. Even with extraordinary men, the end of this has generally been fatal; Mr. Haydon owes it to his "bona indoles" that he has survived to lead a more useful career. After being run after by the crowd, and the master of Eastlake, Lance, and many eminent men, he had almost ceased to enjoy the public countenance. He was little cared for as a martyr, and his pictures had become too academic to satisfy either his own old admirers or the public at large. Then came a change over art, partly, it must be owned, the fruit of his own exertions, the epoch of popular instruction, and he has taken a part, as we have said, in carrying out this great end, which, recalling the kindly feelings of his nature, and bringing him in close contact with the great public mind, the mother goddess, has reanimated his exertions, and directed them towards better ends, and he may rest assured that if he do but show himself worthy, he has awakened such a spirit as will allow no faction to exclude him from public patronage, and no malignity to deprive him of his reward.

We have now to come to his doctrines. Struck with the Promethean fire of the Elgin marbles, he has for years breathed nothing but Greek art, and looking at those works as the masterpieces of the world, he has become their secretary. He holds that high art consists in the selection of the best parts of the best models and in their union, a theory which, however specious it may be, is opposed to all natural laws. Nature always requires a balance of powers, a repose after exertion, and the practical effect of the *to kalon* principle in art has been well shown by Mr. Severn in the last and present number of the *Journal*. It is to vitiate and weaken the hand of the artist, while it produces a work which palls on the eye. We believe that it is possible to produce a greater work than the Transfiguration or the Assumption, but then it is not by going out of nature, but by availing ourselves of it. The all-exquisite, for it is not the all-beautiful, seems not to have been sanctioned by the Creator, nor to be pleasing to his creatures, and a collection of Apollos, Venuses, Theseuses and Ilissuses, are about as unpromising on canvas, as the career of a modern Adonis is represented in an annual, who, too handsome for anything, wished for the horrors of the small pox to relieve him from his splendid misery. The mind will look in the picture for what occurs in the world, and when it knows what English princes and great men are, what an English senate is, and what a mass of human beings is in any place, it cannot attach the idea of nature to the paradisaic creatures who are grouped by the academists. We may look at the Ilissus or the Apollo singly, we may bear the Graces united, but we could not interest ourselves even in the whole family of the Niobes, if they were too much above the everyday standard. It would be well for art if its professors would oftener refer to the politico-economical doctrine that to be beautiful a thing must be fitting, and we should have less of the prettiness of art. That we are very backward in drawing we know, and we are indebted to Mr. Haydon for having called public attention to this defect, but we cannot, and particularly with his own works before us, believe that the *pankalon* or rather the *pantariston* is the right principle in art. To our seeming, his sketches, John Bull at Breakfast and Traveller reading the Times, contain more true art, than any of his recent grand works, and the Mock Election in the King's Bench and Chairing the Member are better worthy of immortality than his infant Mary Queen of Scots, now in the Royal Academy. How Mr. Haydon can reject David and the votaries of lower Greek sculpture on the one hand, and pin himself to elder Greek sculpture on the other, is a phenomenon we do not attempt to explain, we can only say that sculptural partisanship is equally bad whatever may be its standard. Another, but more harmless dogma of Mr. Haydon is the sovereignity of Greek painters, and he talks as confidently of Parrhasius and Polygnostus, and Apelles, as if their master works were at Hampton Court or the Stafford Gallery, and engravings of them in every parlour. That this subject is involved in uncertainty, and that not a fragment exists on which we can build up a judgment, is of course no argument against enthusiasm.

We have devoted this length to an exemplification of Mr. Haydon's views, because they are those propounded in the work before us, and because they are widely disseminated among the public, while we thought we should be rendering a greater service to our readers by warning them against Haydonism, than by giving them another dissertation on trullisatio and marmoratum. Mr. Haydon's lecture is one which the public will greedily devour; according to the modern syncretic and æsthetic phraseology, it is highly suggestive. The artistical part is good, the practical part is good, and with a "cave canem" as to Haydonism, it is all good. It breathes a manly, a kindly, and an English feeling, it reminds us of what our forefathers have done, and if Mr. Haydon and his brethren can but paint as he speaks, the second St. Stephen's shall be painted by Englishmen as the first was. As to his recommendations of painting the house with allegorical illustration of abstract principles, the Blessings of Peace, and the Horrors of Anarchy, it may please advocates of high art and metaphysics, but we would much rather see the Painting of the Potatoe, or the Triumph of Punch, than any such Bolognese and un-English performances. The allegories belong to high art, which if it recommends and executes such things, we think is deservedly named by the bulk of the artists, a great humbug. The commissioners have left in the choice of subjects from our poetry and our history abundant scope for the delineation of nature, and nature let us have.

A Catalogue of Works in all Departments of English Literature, classified with a General Alphabetical Index. By Longman & Co.

In this age of catalogues raisonnées, we suppose we must hail with pleasure any accession to the collection. Messrs. Longman's is a pretty large one, and may be advantageously consulted.

Gandy and Baud's Windsor Castle: Part VII.

As the next part of this publication will be the final one, and will contain the letter-press portion of it, we shall, after that has appeared be able to speak more fully of the work and its character. As far as we can judge in the meanwhile, we must say it appears about to be terminated somewhat abruptly, for there has not as yet been either a single section or interior view of any kind, which is all the more serious an omission, because in this respect, Messrs. G. and B. could have taken a vantage ground that had been neglected by the rival work, and given their own a superior interest, both for professional men and others. As it is, we fear we are likely to get not much more information from the two together, than from either of them separately. Whether it will be the same in regard to the letter-press remains to be seen; we can only say, we trust such will not be the case, there being very little to go over the same historical ground again, more especially as there is such an ample field open for both description and criticism, and for explanatory remark, there being very little of these latter in Mr. Poynter's essay, for that gentleman seems to have been very shy of discussing the architectural merits of Windsor Castle, as it came from the hands of Sir Jeffry Wyatville. Let Messrs. Gandy and Baud's editor make up; and if he at all understands the subject and give it proper attention, he can hardly fail to discover a great many fresh points upon which to touch, or rather, which would very well bear to be brought forward somewhat prominently. At all events, as Messrs. G. and B.'s work will be less extravagant in size, it will be a more readable volume as far as mere form goes; all the more desirable, therefore, is it that it should contain something worth reading, and be entirely free from all that 'cram,' with which those who are employed to furnish a certain quantum of letter-press to books of engravings, are generally apt to eke it out.

Elementary Perspective. By T. J. Rawlins. London: Tilt and Bogue. 1842.

Contains six plates, exhibiting a variety of diagrams both of angular and parallel perspective; it is a cheap work and is well adapted for the beginner.

A Manual of Electro-metallurgy. By George Shaw. London: R. Groombridge, 1842.

A very interesting little work on an important art yet in its infancy, and one that promises to be of the utmost value; consequently whatever information that is given on the subject is extremely welcome, particularly so when all the principal facts connected with the art are fully developed in such a concise manner as they are given in the book before us.

South Eastern Dover Railway—Official Map and Section.

We have before us a most complete, cheap, and extensive map of the South Eastern District of England and part of France, showing this railway and its section, together with all the other railways, and some proposed new branches leading out and immediately connected with the undertaking. It appears to contain a mass of information; and the public, we think, are much indebted to the direction for having it prepared. We have no doubt that it will prove very valuable to all travellers living in the immediate contiguity of the line, or traversing it on their way to the continent. Indeed it is so perfect, that it ought to be possessed as an accessory to the topography of the district.

Two Essays on Radiant Heat. By Thomas Chalmers and Daniel R. Haldane, Students in Arts. Edinburgh: Maclachlan and Co., 1842.

These are Edinburgh academic essays stamped with the approval of the professor, and published for the purpose of giving a popular view of this branch of science, for which purpose we also recommend this joint contribution to the notice of the public; in doing so we cannot do better than quote the words of the Professor:—

"The clearness with which the details of this rather intricate subject have been seized by the authors, renders them, I think, highly creditable as Academical Exercises. In selecting them for publication from amongst others, also of great merit, I wished, in the first place, to mark my opinion of their value in this respect, and, at the same time, to see published in a concise and popular form a correct analysis of experiments which have as yet been but very imperfectly d
and incorporated, even in approved scientific works."

Fractional Arithmetic Reviewed and Practically Exemplified.
Clifford. London: Simpkin and Marshall, 1842.

The doggerel on the difficulties of arithmetic is familiar to ev
according to this authority "fractions" and "distractions" are
and synonymes, and certainly there is no part of arithmetic whi
more trouble to the unitiated. This plague of fractions, bot
and decimal, Mr. Clifford has undertaken to mitigate, by rend
the subject of a particular treatise, in which he has endeavo
smooth away the difficulties.

The Question What can now be done for British Agriculture, ans
a Letter to Philip Pusey, Esq., M.P., President of the Roy
cultural Society. By J. Bailey Denton, Land Agent.
Ridgway, 1842.

Mr. Denton's answer to this question is the introduction of a
and uniform system of drainage, with a profitable distribution
surface and drainage waters and the refuse of towns; and in
priety of such a measure every one will concur. It suffices
that Mr. Denton has urged on the agriculturists an important
in an able manner. There is much however to be said on bot
as to their salubrious effects, on account of the employment of
in the neighbourhood of great towns.

The Cabinet Cyclopædia, a Manual of Electricity, Magnetism,
teorology. By Dionysius Lardner, D.C.L., F.R.S., &c.,
London: Longman and Co. 1842.

This is the first of two volumes in which Dr. Lardner prop
treat the subject of electricity and the cognate sciences in a
manner. The present volume takes up the elements of electr
and dynamics, magnetism, electro-magnetism, thermo-electric
electrical machines. To say that this has been done in a n
manner is scarcely necessary to those who recollect the p
volumes of the cyclopædia, and the satisfactory way in whic
were executed. The next volume will treat of the applica
these sciences to the practical pursuits of life, and we anticip
ourselves and our readers much gratification in the perusal.

A Series of Diagrams illustrative of Mechanical and Natural
phy, and their Practical Application. Drawn on Stone by H.
man, and printed in colours by C. F. Cheffins. London: C
and Hall. 1842.

These splendid diagrams, the first number of which, treating
lever, lies before us, do much credit to the patronage of the
for the Diffusion of Useful Knowledge. They have been conf
the care of Mr. Chapman and Mr. Cheffins, who have produced
which, to the professor and the pupil, the engineer and the wo
will be found of interest and of value. The style of the tinte
graphy does Mr. Cheffins great credit.

The Grainer's Guide. By Charles Moxon. Edinburgh, 1842

This is a class of works which we much wish to see extende
class of practical works by practical men. The reasons whi
Moxon gives for treating upon the subject of graining and im
marbles, we much wish that we could give at length; suffice it
the publication of this work he has supplied a desideratum in
cal literature, and rendered a great benefit to the workman.
work is a large one, and yet of a moderate price, while the spe
which are numerous and on a considerable scale, are nearly
cuted by hand. The letter-press is of course a minor feature
a work, but the directions are sufficiently copious, while, a
emenate from a practical hand, they are calculated to be highly
and to abridge in many cases the labour of the workman, an
extend the sphere of his employment. When we consider th
extent to which graining is now used and the desirableness of
well instructed workmen, we feel indebted to Mr. Moxon for his
tions, and we are sure that he will reap his reward in the patron
his book by the public, both as a work of art, and one of pr
utility.

Lectures on Architecture, with reference to the Proposed Metropolitan Music Hall. By JOSEPH HANSOM, Architect. London: Barth, 1842.

Mr. Hansom erected the Town Hall at Birmingham, which is 82 feet high to the apex of the pediment, 104 feet wide at the base, and 166 feet long; he now proposes to erect a national Music Hall for £30,000, which shall be half as large again as Westminster Hall, and be 150 feet square and 121 feet high, with a recess of 100 feet wide and high and 25 feet deep, for the organ and part of the orchestra. The orchestra is proposed to advance into the room at the base, and there occupy its whole width 150 feet; it will ascend into a slope and to an altitude which the designer compares to that of the side of a hill of considerable steepness and magnitude, manned with an army of musicians, 2500 singers and performers. The Hall is to be capable of containing 8000 persons, and even in case of need 15,000; the price of the organ, which is to be the largest in the world, is included in the estimate of £30,000. The roof Mr. Hansom proposes to construct on the principle of the suspension bridge, from the four corners of the building. The roof to be of iron, and to weigh 200 tons. The height he says is less than that of the cathedral of Amiens, which is 140 feet, of Beauvais, which is 160, and of Cologne, Milan, Strasburg and others. He further offers for £1000 to build a model Hall as large as Exeter Hall, and observes that Exeter Hall is engaged every evening till September, except Saturday, at twenty-five guineas per night. Mr. Hansom promises wonders, but he has done so well hitherto that we must not distrust his success for the future.

A Hand Book of Ornamental Mapping and Engineering Drawing, No. 3. By BENJAMIN P. WILME, C.E. and Surveyor. London: Weale, 1842.

Mr. Wilme perseveres in his labours. In the present number, one of the plates affords delineations of the several classes of timber, other various signs used in mapping, and also the method of showing strata in section, and likewise the method of delineating mountains.

First Additional Supplement to the Encyclopædia of Cottage Farm and Villa Architecture and Furniture. By J. C. LOUDON, F.L.S., &c. London: Longman and Co. 1842.

MR. LOUDON's indefatigable exertions in the cause of making architecture popular, has induced him to continue his Encyclopædia by giving occasionally supplementary numbers, by which means he will be able to collect together a vast variety of useful domestic improvements, not only in the construction of buildings, but also in the fittings and furniture. The part before us fully testifies the utility of such a work; it is full of wood engravings of cottages, villas, inns, schools, &c.

OBITUARY.—It is with regret that we have to record the death of Mr. Samuel Seaward, who died on the 11th ult. He was one of the partners of the firm of Messrs. John and Samuel Seaward and Capel, of the Canal Iron Works, Limehouse, a member of the Royal Society, and an indefatigable member of the Institution of Civil Engineers. He devoted great attention to the construction of the steam engine, and was the patentee of several improvements, and author of a variety of papers read before the Institution of Civil Engineers, on a comparison of long and short stroke engines, auxiliary steam power applied to sailing ships, &c.

STEAM NAVIGATION.

THE STEAM SHIP "LITTLE WESTERN."

SIR,—If you reperuse the article on this vessel, inserted in your excellent Journal for the present month, I have no doubt you will agree with me that it contains an assertion which is not borne out by the rest of the article; and I think that the writer, in making a public statement to her prejudice, was bound in fairness to state the grounds on which it was based. I allude to the following expression: "that there is anything either in the structure of the hull or machinery pre-eminently excellent we utterly deny. In the production of the vessel, there appears to have been too great a straining after novelty, and there are evidences of a disposition to select arrangements, not so much by the consideration of what is excellent as of what is unusual."

I know not whether so strong an expression as that which forms the first part of the above extract was called for: I can only say that I have made several trips on board the vessel, and have thus had many opportunities of seeing and conversing with several gentlemen interested in her, and I never heard them boast of her excellence in exaggerated terms; they merely expressed their confidence of her surpassing the Herne Bay and Gravesend boats, and, as far as I have had an opportunity of judging, that confidence is by no means unfounded. On Monday last, returning from Ramsgate, the *Little Western* left the pier at Herne Bay about twenty minutes after the *City of Canterbury*, and passed her off Gravesend, which shows her speed to have exceeded that of the latter vessel in the ratio of about 8 to 7. At the Nore, the *Orwell* was quite out of sight, and we passed her with great ease near Woolwich if I recollect right. To the best of my observation, the distance from Gravesend to Blackwall was performed in five or ten minutes less time than by the *Railway*, but that boat was too far a-head to allow of any certainty in the observation. On a former occasion, I have been informed, the *Little Western* beat the *Railway* by one mile from Long Reach to Blackwall.

You will perceive that the chief part of the statements contained in this communication are made from my own observations, to which I have added some information which I obtained on board. The latter is not so ample or satisfactory as I could have wished, or might probably have been enabled to communicate, had I had the advantage of seeing Mr. Morgan himself, from whose designs and under whose inspection the vessel and machinery were constructed.

With regard to the second portion of the above extract, I have committed to paper a few remarks, which, in justice to the spirited and enterprising firm of Acraman, Morgan, and Co. by whom the *Little Western* was produced, I should be glad if you would favour them with insertion in your forthcoming number.

It is apparent that the writer of the article above alluded to had never seen the engines at work, or he would not have expressed himself so doubtfully on the subject of the air-pumps, nor have been led to assign undue importance to an evil, whose absolute existence may indeed be indicated by theory, but which the same theory more closely followed up, must have shown to exercise but a trifling, if not inappreciable influence on the result. I will not unnecessarily trespass on your valuable space, by dilating on the advantages of their construction, as the writer of the article in question was fully impressed with their value; but, with respect to the evil apprehended by him, viz., the accumulation of air beneath the plunger, I can assure you, Sir, from my own experience, that it does not exist to any serious extent, having found the vacuum in the condenser, by actual inspection of the gauge during several trips, to range from 27¼ to 27½ inches. It is clear, that there is, strictly speaking, no *accumulation* of air, for that would necessarily end by bringing up the engine; but, as soon as the vacuum has been formed to the degree above stated, the air pump is capable of maintaining it at that degree, by discharging all the injection and condensation water, as well as the air involved, during each revolution of the crank. I may here observe, that the vacuum is unavoidably impaired by the great velocity of the piston. This is the only part of the vessel or machinery to which, as I can make out, the writer takes exception, and that only on vague and uncertain grounds; he passes over all the other details without comment, though he praises in deservedly high terms the workmanship of the engines generally.

Now where, I would ask, is the "great straining after novelty?" I believe the only absolute novelties are the structue of the hull and the horizontal position of the cylinders as applied to beam engines.

With respect to the former, the ribs of the vessel, as stated in the articles referred to, are of T iron, and the exterior or shell consists of two-inch plank, the whole being firmly united together by means of wrought iron braces, both between and on the inner side of the two thicknesses of plank, the former being placed in one diagonal direction. The combination of strength and lightness, as well as the saving of space attained by this construction, which was designed by Mr. William Morgan, are obvious, and it cannot therefore be said to have been "selected, not so much by the consideration of what is excellent, as of what is unusual." Such an assertion would impute nothing short of insanity to Messrs. Acraman and Co., for what man in his senses would build a vessel for sale on a novel principle of construction, and by that very circumstance liable to meet with prejudice, unless he had reasonable grounds for considering the innovation as a substantial improvement?

Neither can the peculiar disposition of the engines be attributed to so absurd a motive, for I think it can be clearly shown to possess material advantages. The connecting rods can thus be made of a desirable length without raising the paddle shaft too high for the most advantageous action of the wheels, which would not have been possible if the cylinders had been vertical; and the valves can be much more conveniently placed on the upper side of the cylinders. As another advantage of this arrangement may be mentioned that the principal strain is always very nearly horizontal, and divided, through the medium of the diagonal stays, between the columns which support the shaft, and those which support the beam centres, the immediate and obvious effect of which is greater ease of motion to the vessel. The lower side of the cylinder is relieved of the weight of the piston by making the piston rod pass through a stuffing-box in the cylinder bottom.

I think I have satisfactorily shewn that the *novelties* introduced in the hull machinery are attended with beneficial effects, and shall now proceed to consider briefly those parts which are not new.

In the first place the boilers, which are Spiller's patent, have been long known, and have been previously used by several of our leading marine engineers, though, for my own part, I do not admire their principle, since the flame passes directly through them in a vertical direction from the furnaces to the funnel, by which I apprehend much heat must be wasted. The *Little Western's* boilers are, however, much larger than the patentee would have made them, and were made under the direction of Mr. Spiller's chief assistant, by whom the drawings had been previously approved. The steam and eduction valves, being balanced, require very much less power to work them than the slide valve generally used, and they can without inconvenience be made very large; the *Little Western's* are 14 inches in diameter. I have already disposed of the question of the air pumps. The paddle-wheels are Morgan's patent, and their superiority over all others has been successfully tested by twelve or thirteen years' experience.

I beg, in conclusion, to make the following additions and corrections in the data contained in the article above referred to. The cylinders are fifty-one inches diameter, stroke 4 ft.; air-pumps 31½ inches diameter, stroke 2 ft. 6 in.; steam pressure in the boiler 8 lbs. (on Mondav last it was frequently as low as 7. and occasionally 6½ lbs., perhaps sometimes lower still), cut of generally by the expansion valve at ⅔. otherwise by the steam valve at four-fifths; power of the engines, 90 (? 104) horses each, with the full number of revolutions (30), but as they generally make but 28, their power is consequently reduced to 84 (? 86) horses each.

Hoping that the above remarks may be found worthy of attention, and may correct any erroneous impression which the article in this month's *Journal* may have produced,

I remain, Sir,
Your most obedient servant,
PHILALETHES.

London, 24*th March*, 1842.

THE PRECURSOR.

In a former number we made a few remarks respecting this vessel, and we have much pleasure in reverting to the subject. The following are a few of the Precursor's dimensions :—

	Ft.	In.
Diameter of cylinder	6	8
Length of stroke	7	0

Number of horses power 520 the pair (the piston travelling at 245 ft. per minute.)

Burthen 1555 tons O.M., and 1751 tons N.M.

	Ft.	In.
Length from figure head to taffrail	261	0
Length from stem to taffrail	244	0
Length of keel and forerake for tonnage	232	2
Extreme breadth over paddle-boxes	61	10
Breadth on deck between paddle-boxes	37	4
Extreme breadth on deck	41	6
Depth of hold amidships	25	0
Weight of iron in bolts, knees, and fastenings	123	tons.
Weight of copper in bolts, &c.	36	,,
Weight of copper sheathing, 13,000 superficial ft.	10	,,
Weight of machinery, coal boxes, boilers and their water	500	,,
Weight of hull	1800	,,

The computed draught of water, with the full complement of stores, provisions, &c. for an East India voyage, and 960 tons of coals, is 17 ft. 8 in. forward, and the same aft. The vessel is provided with tanks for the stowage of a considerable part of the coal: when the coal stowed in these tanks has been burned. they may be filled with water, thereby preserving the proper trim of the ship, and the requisite immersion of the paddles.

The engines are very similar in their arrangement and general appearance to the engines of Messrs. Maudslay and Co., but stronger. They are a handsome and extremely substantial piece of workmanship, and there are several excellencies in their construction not always to be found in the engines of the Clyde manufacture. A few of these peculiarities we shall notice. The valve casing, instead of being bolted to the cylinder throughout its entire length, is only attached to the cylinder for a short distance at the top and bottom ports. The body of the casing forms a D-shaped pipe, and in the middle of this pipe there is a faucett joint to permit the expansion of the valve casing without occasioning fracture, flexure, or strain. Many engines are unprovided with this appliance, and in large engines the want of it sooner or later occasions serious injury. Previous to the starting of the engine, the valve casing is always hot and the cylinder always cold, and the difference of dimension consequent upon the difference of temperature must either start the joints, bend the cylinder, or tear the ports asunder.

Although the engines of this vessel are of such a large size, the valves may be moved by one hand, even when they are cold and the grease of the packing is congealed about them. This is achieved by means of a wheel like the steering wheel of a ship, which gives motion to a pinion working into a sector on the valve shaft. The eccentric rod is thrown out of gear, by means of a short lever with a roller at its upper end. The roller presses upon the under side of the eccentric rod, and lifts it sufficiently to disengage the pin of the valve shaft lever from the notch of the eccentric rod. This disengaging lever turns upon an eccentric axis, and is so adjusted that the eccentricity acts upou the pinion, which gives motion to the sector, and draws the teeth of the pinion out of the teeth of the sector when the disengaging lever is in a certain position, and that position is the one proper to the lever when the eccentric rod is in gear. By this judicious and elegant expedient the starting wheel can never be driven by the engine, for the same act which throws the engine in gear throws the starting wheel out of gear, and the engine cannnot be thrown out of gear without throwing the starting wheel in gear. In most engines started by wheels this expedient is wanting, and it is really dangerous to approach them when driven by the engines at, as is inevitable, a great velocity.

It is most gratifying to find that the sole plate and condenser are cast in the same piece. The condenser is above the sole plate, and the main centre passes through it. The greater part of the joints appear to be made by the simple contact of the accurately-fitted metal surfaces, without rust, and with merely a little red lead interposed. The cylinders are provided with good large escape valves. The expansion valves are situated in the steam pipe, and appear to be of the ordinary description, with a compound cam, adjusted to several different degrees of expansion. The boilers are fired from both ends; there are four in all of nearly the usual square form, with a passage between them, through which a person may walk; each has four furnaces making 16 furnaces in all. The boilers are not nearly so high as in the Great Western, or in the West Indian mail steam packets constructed in the Thames; and they do not appear to be much if at all longer, although the engines are of considerably greater power. The paddle-wheels are of the most substantial and excellent construction of *any* that we have seen. Of the internal parts of the engines, we cannot be expected to speak from our own observation, but if they are answerable to the external parts they must partake of the praise we have awarded.

If we might be permitted to make a suggestion where everything appears to have been so well managed, we should say that the boilers ought to be clothed more efficiently The fronts of them are without clothing at all, and some of the steam pipes appear to us insufficiently covered. This is a point involving not comfort merely, but also economy of fuel, and we also consider that the wrought iron work is badly proportioned, the cross-heads are too heavy.

The cabins of this vessel are most commodiously and tastefully arranged, and especial attention has been paid to the conditions essential to ventilation, cleanliness, and comfort, in a warm climate. The beams and all the other scantlings are of such dimensions as to ensure abundant strength in every part, and the fastenings and excellent system of diagonal trussing employed are such as to unite all the parts into a rigid and substantial whole.

Steam Navigation on the Thames.—There are now 16 steam vessels running daily between Gravesend and London, the same number to Woolwich, 20 to Greenwich, numerous small steamers, the boats of the Waterman's Company, and of the Old Woolwich Company—between Greenwich and Blackwall; there are eight steam vessels constantly going up and down the river on their way to and from Dover, Ramsgate, Herne Bay, Southend, and Sheerness. The General Steam Navigation Company musters 49 steamers, all sailing from London, a fleet superior to the steam fleet of any of the continental powers, and which carry merchandise and property to the amount of £1,000,000 sterling weekly, and whose consumption of coals exceeds in value £50,000 per annum. There are not less than 50 other large steam vessels trading between London and various ports in Great Britain and Ireland; 23 steam-tugs, carrying from 30 to 100 horse power each, exclusively engaged in towing ships between Gravesend and the Pool; 20 iron and wooden steamers navigating the river above bridge, between London Bridge and Chelsea; 2 constantly running between the Adelphi Pier and Putney, and 5 to Richmond.

The Tartarus steam vessel, Commander T. W. Smith, arrived at Woolwich on Monday, April 23, from the West Indies. She has been upwards of four years in commission, traversing during that period a distance of 73,000 miles, and consuming about 5400 tons of coal, without, in a single instance, being detained one hour from service for repairs to either hull or boilers.

The Hon. Company's Steam Frigate Acbar.—On Sunday at noon, 15th ult this splendid war steamer left her anchorage at Gravesend, bearing the pendant of Commodore Pepper, of the Indian navy, who will assume the command of all the Company's ships-of-war now serving in China, under Admiral Sir W. Parker. The Acbar is a steam frigate of the first class, armed with two eight-inch guns, and four long 32-pounders, with a complement of 160 men, carrying five boats, on two of which are mounted brass 12 lb. howitzers. The engines are of the collective power of 350 horses, manufactured by Robert Napier of Glasgow, and are of a very superior description. She has four copper boilers of about seven tons each. The armoury is filled up with 100 percussion muskets, pistols, cutlasses, and musketoons, &c., the whole in beautiful order, and presenting a most warlike appearance. The Acbar carries 500 tons of coal, which, with a consumption of a ton an hour, will enable her to steam 20 successive days. She made her passage from Gravesend to Falmouth, a distance of 370 miles, in 36 hours, which gives an average speed of more than 10 miles an hour.

American Marine Engines.—We have been both astonished and gratified by the reception of a drawing sent to us from America of an excellent side lever marine engine constructed by Messrs. Stillman and Co. of New York, for two steamers built for the Spanish Government, "El Regent" and "El Congresco." It has been so much the habit of Europeans to regard the American machinery as rude and dangerous, as well as unsuited to vessels intended for the navigation of the ocean—an impression in which, to a certain extent, we ourselves participated—that this drawing has, we confess, surprised as much as it has delighted us; and it is an act of justice we feel called upon to render to say that, so far as this drawing will enable us to form an opinion, Messrs. Stillman's performance will not suffer by a comparison with the work of even the first of British manufacturers. The framing of this engine resembles the framing of Messrs. Fawcett, Caird, and Borrie, and every part of it appears to us well proportioned and arranged. The ingress and egress of the steam to and and from the cylinder is regulated by spindle valves wrought by an eccentric; whether these valves are of the single or double beat description, the drawing does not specify. The eccentric rod is provided with a long nut furnished with a right-handed and a left-handed thread, so as to shorten or lengthen the rod at pleasure. There is an expansion valve of the common description situated in the steam pipe, and wrought in the usual manner. We should have been glad to have possessed more precise information respecting the interior of these engines, as for example, the nature of the piston packings of the valves, air pump buckets, as well as some particulars respecting the construction of the boiler, the consumption of fuel, and the nature of the performance as determined by the indicator. We trust we may be favoured with such details, and no efforts of ours shall be wanting to make the merits of the machinery of America as extensively known and as highly appreciated as its excellence appears to deserve.

PROGRESS OF RAILWAYS.

Railways in France.—The Chamber of Peers assembled on Monday, 9th May, in their committee rooms for the purpose of electing a committee to report on the railway bill, brought up from the Chamber of Deputies. This bill contains—first, a general classification of the lines intended to be constructed; second, a second system of execution, which imposes on the departments traversed by those railways the payment of two-thirds of the value of the ground to be purchased. It likewise enacts that the Government shall pay the remaining third, together with the expense of embankment, the executions of works of art and stations, leaving the cost of fixing the rails and the *materiel* to the charge of the companies who shall undertake to complete them. Third, the allocation of funds amounting together to the sum of 126,000,000f., applicable to the following sections:—

	Francs.
From Strasburgh to Hommartin	11.500.000
„ Dijon to Châlons	11.000.000
„ Marseilles to Avignon	30.000.000
„ Orleans to Tours	17.000.000
„ Orleans to Vierzon	12.000.000
„ Paris to Lille	43,000,000
For sundry expenses	1,500.000
	126.000.000

The entire plan consists of seven vast lines of the first order, setting out from Paris, and leading—1. To the Belgian frontier through Lille and Valenciennes. 2. To England by one or several points on the coast, to be hereafter determined. 3. To the German frontier, through Strasburgh. 4. To the Mediterranean, through Lyons, Marseilles, and Cette. 5. To the Spanish frontier, through Bordeaux and Bayonne. 6. To the Atlantic Ocean by Nantes. 7. To the centre of France through Vierzon, with a prolongation to be hereafter determined, with a branch to Bourges. And of two lines of the second order from frontier to frontier directed—1. From the Mediterranean to the Rhine, through Lyons, Dijon, and Melhouse. 2. From the Mediterranean to the Atlantic Ocean, through Bordeaux, Toulouse, and Cette.

NEW CHURCHES, &c.

Manchester.—On Monday, 28th March, the first stone of a new church, situate in Rodney-street, Oldham-road, was laid by Robert Gardener, Esq. This church is the fourth of those now in course of erection by the "Association for the Building and Endowing of Ten Churches in the Boroughs of Manchester and Salford." Mr. Richard Tattersall is the architect. The Norman style of architecture has been adopted, and both the exterior and interior of the building will be of a highly ornamental character. The church is in the shape of a parallelogram, whose external dimensions are about 78 feet long by 52 feet wide, with a chancel at the east end about 27 feet wide, and projecting 12 feet; at the westerly end there is also a projection about 42 feet wide, and projecting about 20 feet, which contains the entrances to the ground floor and to the galleries, as well as two staircases to the latter, betwixt which, and over the entrances, will be a recess for the organ and choir. The whole exterior of the building will be faced with stone from the Summit delphs, which is to be neatly hammer-dressed, except the ashlar dressings, which are to be neatly tooled. The westerly projection will be flanked by two turrets, terminating in pyramidal weathered pinnacles, surmounted by the old Norman cross, at a height of 66 feet above the level of the street. Betwixt the turrets there will be a boldly recessed arch, supported by small columns. The three chief compartments in the west front are surmounted by archivolt mouldings. In the west gable is a moulded opening for a clock dial, this gable terminates with coping, with chevron cut edges, sustaining a large Norman cross at the apex. Each side of the church is divided into six compartments, with a light in each; each compartment is separated by flat buttresses, terminating in moulded weatherings, and a flat segmental arch with billetted mouldings, turned over each compartment betwixt the buttresses. The chancel stands out quite distinct from the church, being roofed at a lower level, and there will be an eight light circular window in the upper part thereof, and four narrow loop lights in the lower part. The east end of the church will also have a large Norman cross on the apex of the coping thereon, and the whole is to be finished to correspond with the west gable. The recess formed at each end of the interior of the church by the projections outside, will be divided from it by large enriched arches similar to the one in the west front. Although the accommodation required, and the amount to be expended, rendered the introduction of galleries absolutely necessary, great pains have been taken to render them as little objectionable as possible; for this reason the west gallery front will not be carried more than five feet into the church, so that on entering the same nearly the whole of the interior, together with the roof, may be at once seen. On the south side of the west entrance will be the baptistry, with a Norman font, sufficiently large for immersion. In the interior of the upper part of the gable at the west end of the church there is a preparation for a clock dial, to be moved by the same works that move the dial in the west front, and which will also serve for ventilating the church; and there will be an enriched ornament in the east gable to correspond, and also for the purpose of ventilation. The church will have an open timbered roof; the tie-beam of each truss is thrown up about five feet above the lower ends of the principal rafters, where they set down upon the side walls, and the space betwixt the top side of the beams and the under side of the principal rafters is divided into three compartments, by two queen posts, under which are placed enriched pendants, from which proceed curved and moulded ribs, and are continued down the side walls, until they set down upon the capitals of moulded corbels therein, the top side of the capitals being four feet below the bottom ends of the principal rafters in side walls. To avoid the danger of any lateral pressure from this form of truss, cast-iron brackets are enclosed within the curved ribs, and are continued a sufficient distance on the ti beam, so as eventually to convey the whole weight of the roof down upon the stone corbels in the side walls, on which the cast-iron brackets are also made to set down. In the centre compartment, formed by the queen posts in each truss, will be a semicircular curved rib, bolted to the principal rafters. The common rafters are to be wrought and chamfered, and the slate boarding will be wrought on account of being exposed to view. As the pitch of the roof is made to suit the character of the building, this mode of finishing will give great additional height to the interior, and add considerably to the effect, and at a less cost than the more customary horizontal ceiling. The church will afford sittings for 1.075 persons: nearly one-half will be free. The entire cost of the church will be under £3.400.

A New Roman Catholic Cathedral is proposed to be erected on a magnificent scale in York. The ground and buildings have already been purchased, and some of the latter have been pulled down. Upon the site chosen a monastery formerly stood. The ground, which extends from the Holy Trinity Church to the Bar, is to be laid out as a crescent, in the centre of which the cathedral is to be erected. Mr Pugin has been selected as the architect, and the works are to be commenced immediately.

Incorporated Society for building Churches and Chapels.—At the last meeting of this indefatigable and most useful society, held at their chambers in St. Martin's Place, Trafalgar Square, London, the Lord Bishop of Durham in the chair, the principal business transacted was voting money for the following purposes, viz.:—Towards building a church at Westpool, Somerset; for building a chapel at Blackgate, Durham; building a church at Llanfynidd, Flintshire; building a chapel at Kidderminster, Worcestershire; building a chapel at Dursley, Gloucestershire; building a chapel at Hardway, Hampshire; rebuilding the Church at Llanamore, Denbighshire; towards enlarging the church at Arlington, Devon; for enlarging by rebuilding the church at Basford, Warwickshire; towards repairing the church at Holme; Yorkshire: towards building a gallery in and repewing the church at South Lynn, Norfolk; repairing the church at Bradford Abbas, Dorset; building a chapel at Crook, Durham: enlarging the church at Burghfield, Berkshire; enlarging the chapel at Newton Heath, Manchester: being in all sixteen grants, amounting to several thousand pounds, all supplied by voluntary subscriptions to enlarge the means of spiritual instruction, chiefly by increasing free sittings.

Calcutta Cathedral.—The Bishop of Calcutta has forwarded to the Society for promoting Christian Knowledge a report, in which will be found much interesting matter relative to the cathedral in course of erection in that diocese. The bishop says, "It is hoped that in little more than two years from the present time, perhaps on the feast of the Epiphany, 1844, the cathedral may be ready for consecration. The style of architecture originally proposed has been adhered to, except where the climate and soil of Bengal have interfered. It is Gothic, modified by the circumstances just alluded to; that is, Indo-Gothic. The extreme length of the building, including the buttresses, will be 247 feet, and its width 81 feet, and at the transepts 114 feet. The height of the tower and spire from the ground will be 201 feet, and of the walls to the top of the battlements 59 feet. The internal dimensions of the main body of the cathedral will be 127 feet in length by 61 feet, the height 47 feet. The 127 feet will probably be subdivided into a choir, a chancel, and a holy table precinct. The body of the cathedral, if full pewed, will accommodate about 800 persons, and if galleries should be added hereafter, and chairs occasionally placed in the aisles, as is done in all Calcutta churches on the great festivals, 1300 or 1400. The transepts also, lantern, and western verandah, should they ever be wanted for congregations of catechumens or Sunday schools, would furnish above 400 additional seats. The capacity of the cathedral will not be less, therefore, than for 1700 persons. But the arrangement of the sittings will be ruled by circumstances and the convenience of the congregation, as all the stalls, pulpits, reading-desks, pews, and benches are intended to be moveable.

MISCELLANEA.

A NEW CEMENT, A SUBSTITUTE FOR GLUE AND CAULKING.

Amongst the numerous inventions submitted to the Lords Commissioners of the Admiralty, and referred by their Lordships to the committee of master shipwrights recently sitting at Woolwich dockyard, was a composition to be used in place of the substance with which vessels are at present caulked to render them water-tight. The experiments ordered to be made by the master shipwrights to ascertain its value when applied to the purpose for which it is intended, and the result, are interesting and satisfactory. Two pieces of African teak, a species of wood difficult to be joined together by glue, on account of its oily nature, had a coating of the composition applied to them in a boiling state, and in a short time afterwards bolts and screws were attached to each end, the joined wood placed in the testing-frame, and the power of Bramah's hydraulic engine applied to the extent of 19 tons, when the chain broke without the slightest strain being perceptible where the joining took place. A larger chain of one inch and a half in diameter was then applied, which broke with a strain of 21 tons, the joint in the wood remaining apparently as firm as at first. The utmost strain the cement can bear in this form, therefore, remains to be proved when experiments are made with larger chains. Four pieces of hard wood were then joined together, weighing in one piece 44 cwt., and carried to the top of the shears in the dockyard, a height of 76 feet, from which it was precipitated on the hard granite wharf wall below, without any of the joints yielding in the smallest degree. The results of these severe tests induced the Lords Commissioners of the Admiralty to communicate with Lieutenant-General Sir George Murray, G.C.B. and G.C.H., for the purpose of making experiments with it in the marshes at Woolwich, by bringing the full force of canon balls against it. Accordingly, a number of planks of oak 8 inches thick and fir 16 inches square were joined together with the cement, to tegether 8 feet in height and 8 feet in length of the side of a first-rate ship of war, without anything else in the shape of bolt or security to assist the composition; and it was set up as a target at the butt in the marshes. when a number of officers of the Royal Artillery were present to witness the experiment. Three shots were first fired, every one entering the target, the third in a direct line with the bull's-eye within three inches of its outer circle. The effects of these shots were wonderful, they tore the wood to pieces, and in only one instance, where the joint had not been good, they had no effect upon the cement.—A hole six inches and a quarter in diameter was then bored in the centre of the target, and an 32-pounder shell inserted and exploded by a match, which tore the wood to small splinters without in many places in the least separating the composition. This new invention is said to possess the power of expanding like India rubber in warm climates, and will not become brittle under the coldest temperature. It appears to be a great favourite with naval officers, as it is so clean, having only the appearance of French polish. The name of the inventor is Mr. Jeffrey.

The substances of which *the cement is composed* are simple, being merely *shell-lac and india-rubber dissolved in naphtha* in certain proportions; and being insoluble in water, the purposes to which it may be applied are numerous. Its value is about half the expense of common glue, the saving to the country by its universal adoption will be incalculable, as the inventor has been employed in experiments with it for upwards of two years, and has found that in the absence of great friction it is in a manner imperishable. An experiment was tried in the dockyard, which shows the value a supply of the cement will be to vessels which may be damaged at sea. Eight pieces of wood were joined together in the form of a mast, and a strain applied to them and to another mast of one piece of wood. The latter gave way first, and the other only broke after being considerably bent and the application of a rather great strain. By this substance, therefore, it is certain that ship carpenters can have no difficulty in effecting repairs at sea, which could not be done under any other circumstances.

Scott's Monument.—An engraving has just been published, from a drawing by the architect, Mr. Kemp, of the monument to the memory of Sir Walter Scott, at Edinburgh. It is a Gothic elevation. something in the style of what are called "crosses," and bears in some portions a resemblance to the great tower of the Cathedral at Antwerp. It is in style between the florid and the simple Gothic, having flying buttresses, finials, crockets, &c., and being ornamented with quatre feuiles, and more minute embellishments. There are many tabernacles, but they are not occupied by figures. The statue of Sir Walter is placed in the centre, beneath the principal arch; it is robed in a flowing drapery, and stands on a pedestal. The pedestal does not partake of the character of the building, and gives rather an incongruous effect to the whole. There is an appearance of lightness and elegance about the design, but it may be questioned whether the building has not too much of the monastic or clerical style to suit exactly the character of him it is intended to commemorate.

Patent Wire Rope.—These ropes are likely, on account of their economy, to become of extensive use for forming foot bridges over canals, and deep cuttings of railways. Two wire ropes made at Mr. Andrew Smith's works at Poplar, 100 ft. long, 2½ in. in circumference, and weighing 2¼ cwt.. cost 5*l.* 5*s.* formed the main chain for a suspension foot bridge on the South-western Railway, near the Weybridge station.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 28TH APRIL TO 26TH MAY, 1842.

Six Months allowed for Enrolment, unless otherwise expressed.

Henry Barclay, of Bedford-row, for "*a composition or compositions applicable as tools or instruments for cutting, grinding, or polishing glass, porcelain, stones, metals, and other hard substances.*"—Sealed April 30. (Four months.)

John Robinson, of Watney-street, Commercial-road East, engineer, for "*improvements in windlasses and capstans.*"—May 3.

John Railton, of Blackburn, machine-maker, for "*certain improvements in machinery or apparatus for weaving.*"—May 3.

Godfrey Wetzlar, of Myddleton-square, Clerkenwell, for "*improvements in rendering fabrics water-proof.*" (Being a communication.)—May 7.

Joseph Warren, of Heybridge, Essex, agricultural implement maker, for "*certain improvements in ploughs.*"—May 9.

Francis Prime Walker, junior, of Manchester, coal merchant, for "*certain imprpvements in the manufacture of candles, candlesticks, or candleholders, and in the apparatus connected therewith.*"—May 9.

George Haire, of Manchester, gentleman, for "*certain improvements in machinery or apparatus for sweeping and cleaning chimneys and flues.*"—May 9.

Thomas Edge, of Great Peter-street, Westminster, gas apparatus manufacturer, for "*certain improvements in apparatus for gas-water and other fluids.*"—May 9.

Samuel Hall, of Basford, C.E., for "*improvements in the combustion of fuel and smoke.*"—May 9.

Jacob Wilson, of Wigmore-street, Cavendish-square, upholsterer, for "*certain improvements in bedsteads.*"—May 9.

William Sanderson, of Aldermanbury, London, silk-manufacturer, for "*improvements in weaving fabrics to be used for covering buttons.*"—May 9.

John Melville, of Upper Harley-street, Esq., for "*certain improvements in propelling vessels.*"—May 11.

John Browne, of Brighton, gentleman, for "*improvemeuts in the manufacture of mud-boots and overalls.*"—May 12.

Thomas Williams, of Bangor, smith, for "*an improved churn.*"—May 17.

William Brunton, of Neath, Glamorgan, C.E., for "*an improved method or means of dressing ores and separating metals or minerals from other substances.*" (For the colonies only.)—May 19. (Four months.)

Joseph Gibson, of Birmingham, manufacturer, for "*certain improvements in axletrees and axletree-boxes.*"—May 23.

John Bennet Lawes, of Rotherhampstead, Hertford, gentleman, for "*certain improvements in manures.*"—May 23.

John Bishop, of Poland-street, Westminster, jeweller, for "*a new or improved construction of brake apparatus applicable to railway carriages.*"—May 23.

Thomas Middleton, of Loman-street, Southwark, engineer, for "*an improved method of preparing vegetable gelatine or size for paper, and also an improved mode of applying the same in the manufacture of paper.*" (Being a communication.)—May 23.

William Tudor Mabley, of Henrietta-street, Covent-garden, mechanical draftsman, for "*improvements in machinery or apparatus for making nails.*" (Being a communication.)—May 23.

Benjamin Cook, junior, of Birmingham, brass-founder, for "*improvements in the construction of bedsteads, both in metal and wood.*"—May 23.

Frederick Goos, of Manchester, jacquard machine-maker, for "*certain improvements in the jacquard machine or apparatus, to be used or employed in looms for weaving.*"—May 23.

Sir James Murray, of Merrion-square, Dublin, Doctor of Medicine, for "*an improved method of combining various meterials in a manner not hitherto in use for the purpose of manure.*"—May 23.

James Pilbrow, of Tottenham, engineer, for "*certain improvements in steam engines.*"—May 23.

William Geeves, of Old Cavendish-street, gentleman, for "*improvements in machinery for cutting cork.*"—May 24.

James Stewart, of Osnaburgh-street, Regent's-park, piano-forte maker, for "*improvements in hinges for piano-fortes and other purposes.*"—May 24.

Thomas Waterhouse, of Edgely, Chester, manufacturer. for "*a certain improvement or improvements in machinery for carding cotton, wool, flax, silk, and similar fibrous materials.*"—May 24.

Joseph Duce, of Wolverhampton, lock-manufacturer, for "*an improved lock and key to be used therewith, and an improved slide bolt for the said lock, applicable also to other purposes.*"—May 24.

James Boydell, junior, of Hope Farm Works, Dudley, for "*improvements in the manufacture of keel plates for vessels, iron gates, gates-posts, fencings, and gratings.*"—May 24.

James Potter, of Manchester, manufacturer, for "*certain improvements in machinery for spinning cotton, flax, ond other fibrous substances.*"—May 25.

Peter Kagenbusch, of Whitby, York, for "*an improvement in the dying of wool, woollen cloths, cotton, silks, and other fabrics and materials.*"—May 26.

TO CORRESPONDENTS.

"A Land Surveyor" *will see that we have complied with his request; we* [illegible] *endeavour to give the magnetic variation periodically.*

"O. T." *We have received his valuable communication on iron, &c.; he* [illegible] *hear from us by post.*

"B. G." *His communication was accidentally mislaid—we will answer it* [illegible] *month.*

"A Subseriber" *will find in the October Number of* 1840, *Vol.* 3, p. 334, [illegible] *for computing the amount of earthwork in cuttings, embankments, &c., by* [illegible] *Hughes.—Geological communications are admitted in the Journal.*

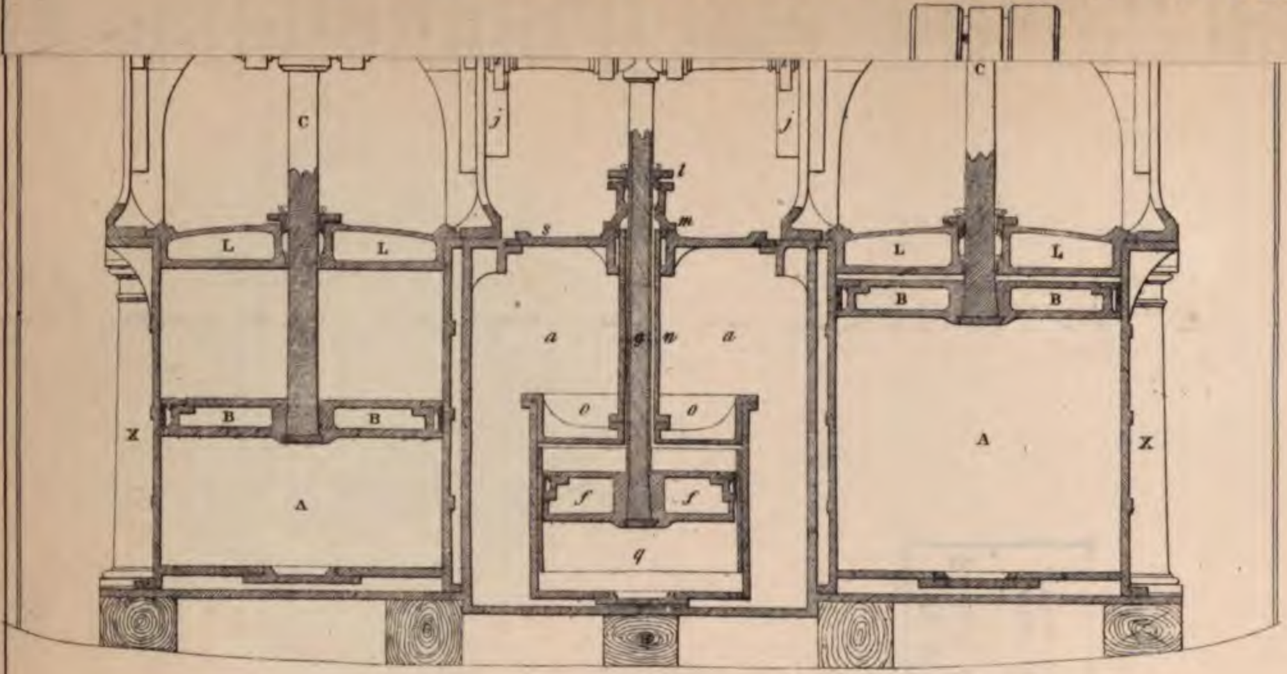
"Juvenis." *We have no knowledge of any locomotive engine having been* [illegible]*structed upon the plan proposed by him.*

"A Subscriber of Derby." *The conventional marks* H *indicate that the* [illegible] *and fence D. & B. belong to him, and on A to his neighbour. We do not* [illegible]*stand the sign on the side C; we have never seen it used in the way shown.* [illegible] *area of the field will also be a guide or rather a check; the quantity belonging to him can be computed from the plan, as the boundary lines are drawn* [illegible] *the verge of the ditch.*

Books for Review must be sent carly in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the [illegible] *instant.*

Vols. I, II, III, and IV, may be had, bound in cloth, price £1 each [illegible]

DIRECT ACTION ENGINES BY P. BORRIE & C° DESIGNED NOV^R 1841.



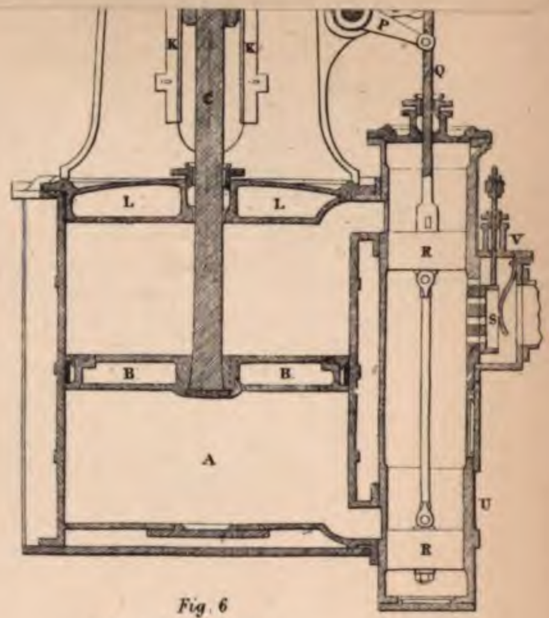
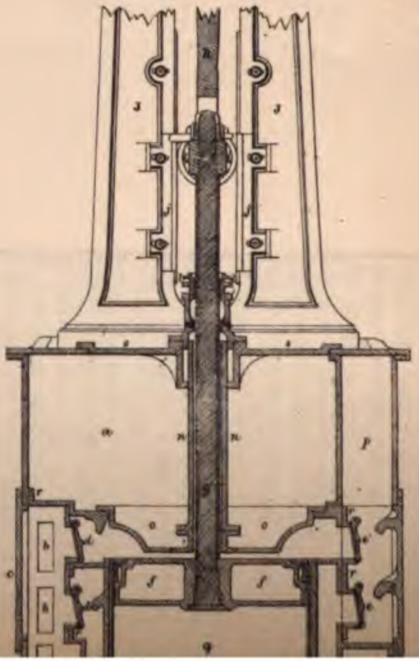


Fig. 6



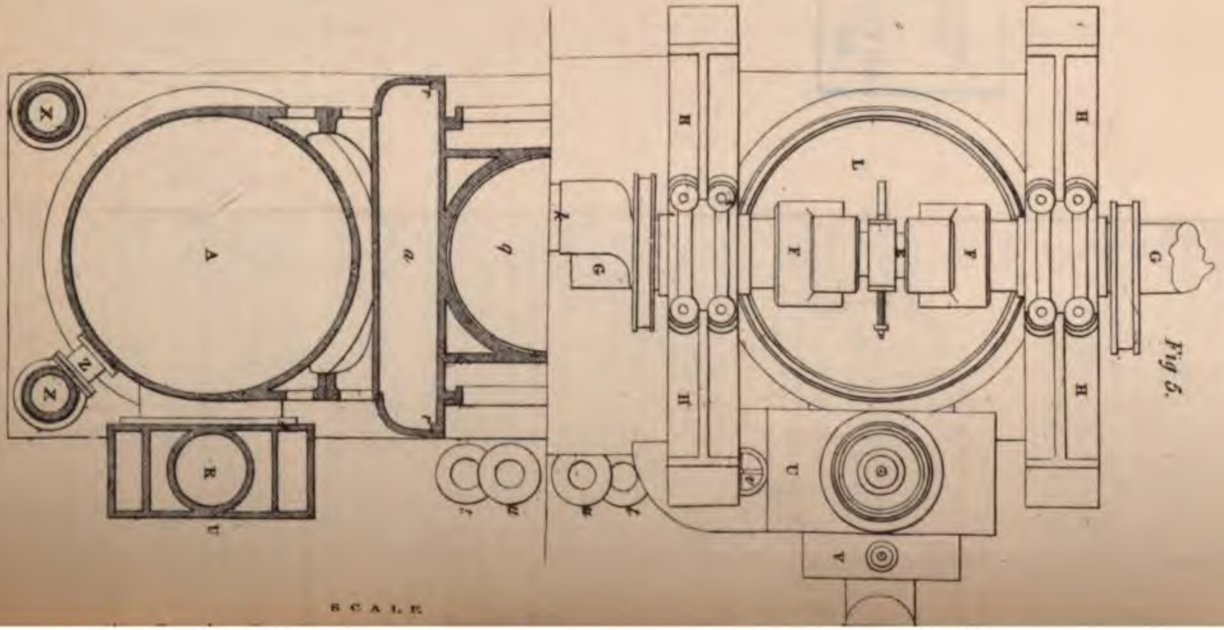


Fig 5.

SCALE

THE NEW YORK
PUBLIC LIBRARY

ASTOR, LENOX AND
TILDEN FOUNDATIONS

MARINE ENGINES,

By P. Borrie & Co., Engineers, Tay Foundry, Dundee.

Designed November, 1841.

(With an Engraving, Plate VIII.)

These engines belong to that class generally denominated direct action engines: in this respect they are similar to other engines of that class. Their peculiarity consists in the novel arrangement of the air pump and condenser. The following particulars of their construction and peculiarity have been furnished us at our request, by Messrs. Borrie and Co.

The collective power of the two cylinders by formula,

$$\frac{\text{area of cylinder} \times 7 \times 210}{33{,}000} = 352 \text{ horse power,}$$

but by taking the pressure on the piston at 8·5 lb., and the velocity at 215 ft. per minute, the power will be 426 horse power. The strength of the engines and evaporating power of the boilers are adapted for the full power. The engines occupy a space of 10 ft. fore and aft the vessel, and 22½ ft. transversely. The engines, boilers, space for firing boilers, and coal boxes, capable of containing 400 tons of coals, calculated at 48 cubic feet per ton, in a vessel with engine room in the clear 34½ ft. broad, by 23 ft. deep, only require 55 ft. fore and aft. The ordinary length fore and aft allowed in the Government steamers for engines, &c. of the above power is 65 ft. With 65 ft. 560 tons of coals can be stowed in the coal boxes. With these engines, therefore, a space of 10 ft. fore and aft the vessel may be made available for other purposes, or an additional 160 tons of coals to the ordinary quantity apportioned to the coal boxes. The coal boxes are so arranged that they afford protection to the engines and boilers from shot, which are placed below the vessel's load water line.

The weight of one pair of engines	110 tons.
„ the paddle-wheels (common construction)	25 „
„ the boilers, with mounting	81 „
„ the water in boilers	55 „
„ the coal boxes	18 „
Total	289 tons.

The following explanation will show the construction of the condenser and air pump:—One condenser, *a*, fig. 6, and one air pump, *q*, serve for both engines. The air pump is double acting, and has four valves, *d' d e' e*. The valves *d' d* correspond with the foot valve, and the valves *e' e* with the discharge valve of an engine fitted with the common lifting air pump. This description of air pump has pistons similar to those used in steam cylinders, and packed with metallic packing in the same manner. Communicating with each end of the pump there are valves opening inwards, *d' d*, and others outwards, *e' e*, being four valves to each pump; by this arrangement the piston, *f f*, alternately draws and forces, at each half stroke of the engine. The passages are of one casting with the pump, next and jointed to the sides of the condenser, as at *r r r r*; doors, *c c*, on the sides of the condenser opposite these passages admit of ready access to the valves: the pump is placed at the bottom of the condenser. To render a stuffing box unnecessary on the pump cover, *o o*, for the pump rod, a tube, *n n*, extends from the pump cover, *o o*, to the cover on the top of the condenser, *s s*, in which the pump rod, *g*, works: a suitable stuffing box, *m m*, and gland, *l l*, for the pump rod are provided in the cover on the top of the condenser. The double action air pump possesses several advantages over those of the common construction; among these it may be noticed that one double action pump will do the work of two with only the friction of one single action pump, the dimensions of both being equal; so one of the former to do the same amount of work as one of the latter will only require to be of half the area, with the same length of stroke. The effective action of this pump being at every half stroke, a much steadier and purer vacuum will be maintained in the condenser than by the common pump, whose action is only at the termination of every full stroke of the engine. Its liability to become deranged is not greater, and the difficulties in remedying these derangements when they have occurred are less than in the common pump. Connected with the latter are the foot, discharging, and bucket valves; for obtaining access to either of the first two of these valves, the jointing of a separate door has to be undone, and for the third several disconnections have to be made, and the air pump cover has to be lifted. In some arrangements of engines the whole of these valves are of very difficult access; to obtain access to the valves in the double action pump the undoing of two doors is only necessary. Although the valves at one end became deranged in action, yet the pump with the valves at the other end would work as a single action pump, and the engines continue in operation until opportunity was afforded for repair. The repair could be very speedily effected, by always having in readiness a set of valves to replace those that became defective. If the valves of the common pump get deranged, the working of the engine is completely suspended. In the arrangement of engines with this pump, it is shown in fig. 6 as wrought by a crank, forged of a piece with the intermediate crank shaft of the engines. The perpendicular position of the pump rod is maintained by a guide pulley, *i i*, working in guides, *j j*, bolted to the engine framing, I I.

It has been correctly maintained that an engine air pump with a solid piston or plunger, as hitherto constructed, will not produce so pure a vacuum as a lifting valve bucket of the common construction. This will hold true in respect to a single action plunger air pump which only expels the water and gases by its downward stroke; for as the gases are always in position above the surface of the water to be expelled, the descent of the plunger will lessen their volume and increase their density to an extent corresponding to what would result from being subjected to a pressure equal to that required for expelling the water. There being always a head of water in the hot water cistern pressing against the discharge valves, these gases can only be very partially expelled from the pump chamber. On the ascent of the plunger, and re-opening of the valve communicating with the condenser, they (the gases) will partially return to the condenser, (as a less head of water in a partial vacuum will offer less resistance to their ingress,) and partially impede the free flow of the water in it to the pump chamber. These defects impair the efficiency of the engines, from the consequent imperfect condensation, and impurity of vacuum; no such defects obtain in a double action force pump, as applied to an engine. In fig. 6 it will be noticed that the passages between the air pump and three of the lower sides of the condenser will always be filled with water, during the ascending stroke of the plunger piston to a level with the lower side of the piston plunger, and during the descending stroke to a level with the lower part of the upper foot valve seat. These passages, however, being specially made of very small cubical capacity, will not admit of more water remaining in the bottom of the condenser, on the cessation of the engines from work, than what remains in a condenser and bottom of air pump chamber of the common construction. The difference between the level of the lower side of the piston plunger and the lower part of the lower foot valve seat only admits of the water entering into the pump chamber during the ascent of the plunger, in the limited time afforded by a half revolution of the crank. This precludes an ingress, to any injurious extent, of gases to be acted on by the return of the plunger, in manner as resulting from the use of a single action plunger pump; but on the upper foot valve opening, during the descent of the plunger, opportunity is afforded for the admission of the gases into the upper part of the pump chamber. During the ascent of the plunger, these gases being in position above the surface of any water that may have entered with them, will be first expelled through the upper discharge valve, *e'*, into the hot well, *p*. The expulsion of the gases by a double action plunger pump is, therefore, as efficiently accomplished as by the common bucket valve pump; and the objections against the use of a single action force pump, when urged against it, are unfounded.

In the drawings and description one of these double action air pumps is represented as sufficient for two engines, but under certain circumstances two would be preferable. The space and weight required for a pair of engines with two double action air pumps would not much exceed the space and weight with one, and still be very considerably under what two common bucket valve pumps would require.

Reference to the Engraving.

Figs. 1 and 2 side view; figs. 3 and 4 section; fig. 5 plan; and fig. 6 section of air pump and condenser. Similar letters refer to similar parts on all the figures: A, cylinders; B, pistons; C, piston rods; D, connecting rods; E, crank pins; F, cranks; G, crank and paddle wheel shafts; H, crank shaft entablatures; I, framings; K, piston cross-head guides: L, cylinder covers; M and N, force and bilge water pump wipers; O and P, steam valve, traversing shaft wipers; Q, piston valve spindles; R, piston valves; S, expansion valves; T, cross head guide pulleys; U, piston valve casings; V, expansion valve casings; W, steam pipe glandular joints; X, columns forming lower part of framing; Y, engine deck beams of vessel; Z, cylinder water scape valves.

Fig. 3: *a*, condenser; *b*, passages from condenser to foot valves; *c*, valve doors; *d' d*, upper and lower foot valves; *e' e*, upper and lower discharge valves; *f*, air pump piston plunger; *g*, air pump plunger rod; *h*, air pump connecting rod; *i*, air pump cross head pulley guides; *k*, crank for working air pump; *l*, air pump piston rod gland; *m*, air pump piston rod stuffing box; *n*, pipe for rendering unnecessary a stuffing box on air pump cover; *o*, air pump cover; *p*, hot well cistern; *q*, air pump chamber; *r*, jointings of air pump to sides of condenser; *s*, condenser cover; *t*, bilge water pumps; *u*, feed pumps; *v*, valves for closing eduction passages, in the event of one engine being wrought singly.

THE ROYAL MAIL STEAM PACKET COMPANY.

We admire the adventure and majesty of this undertaking; we respect, both as merchants and men, those who preside over its destinies; but we look upon them as the most ineligible managers of a steam packet company that the annals of steam enterprise can exhibit, and are quite worn out with the untractable incapacity which shines through all their proceedings. Never was an enterprise begun under happier auspices. With a directory numbering some of the most august names among British merchants, with an influential connexion abroad, a most respectable proprietary at home and a most beneficial contract with the Government, success appeared certain and rivalry impossible; and never did mismanagement more effectually render "these rich gifts poor," or more speedily transform a scene of noble promise into a chaos of withered hopes, forlorn greatness, and wide-spread desolation.

We have patiently waited month after month, in the fond hope that some such amelioration would be accomplished as would at least give the enterprise a chance of success. We have suggested—we have remonstrated—we have entreated: and holding in mind the deep interest which many of our friends have in the undertaking—considering the baneful effect which the mismanagement of this company would indirectly exercise upon other companies, even the best managed—and foreseeing the deplorable consequences that would ensue to the national interests in general, and to the interests embarked in steam navigation in particular, from the utter failure of this scheme—we have left no stone unturned to induce the voluntary adoption of such measures as are best calculated to avert such a catastrophe. But it all will not do. The directors, deaf to the outcry of the public, which is roused to a man against them—regardless of having rendered themselves the subjects of unprecedented odium and universal derision—heedless of the pressure of accumulating difficulties, which every instant threaten to overwhelm them—*persevere*, nevertheless, in the very course that has already created all these disasters, and are still distinguished only for the same inordinate self-sufficiency, the same futile dogmatism, and the same wanton temerity, which characterized the first hour of their hapless administration.

It becomes, then, a question of supreme importance, What remedy is to be sought for this state of things? and it concerns the proprietary deeply that a prompt and judicious answer should be given to this question. Happily the answer is not a difficult one; for as it would appear to be indisputable, and is indeed the universal sentiment, that mismanagement has occasioned all the past evils, the obvious way to prevent the recurrence of those evils is to change the management. This, we presume, the proprietary have it in their power to do; and if they have not, it would be a thousand times better to break up the Company altogether, than to endure the continuance of the present alarming state of things. It is the wisest policy to look the difficulties of the question fairly in the face, and certain it is that a bad compromise now is better than the prosecution of a scheme which, under the existing conditions, must terminate fatally. It is high time that the proprietary should search the business to the very bottom *for themselves*, and *insist upon* the execution of such measures as are essential to the general good. It is the only chance they have of saving any thing from the embers.

The very christening of this Company introduces us to—if not a species of artifice, at least to something so very like it that we are at a loss for any other name by which to distinguish it. We should be glad to know why this company is called "The Royal Mail Company," as if there were no other Royal Mail Companies besides it. The City of Dublin Company, the Peninsular and Oriental Company, the Halifax Company, and others, are quite as much entitled to the appellation as this helpless leviathan; they, too, carry letter bags: and whether the design of this arrogated distinctive title was or was not to delude the ignorant into the belief that this Company possessed some peculiar immunity, or maintained some intimate species of connexion with Government not common to its contemporaries, such certainly has been the effect. But we pass over this trifling delinquency—though, in our eyes, unfair to other companies, and unworthy of a great enterprise, to notice topics of more stirring interest.

The assumed average speed of the vessels is at least one knot per hour too high.—The vessels have never kept their times, and they never can do so. The computations of the average speed are founded upon hypothetical and visionary considerations, not upon a knowledge of the performance of other vessels. The average speeds of the Great Western and the Tagus, as determined by the actual results of a number of voyages, are 8·3 and 8·25 knots respectively; and those vessels are among the most efficient afloat, certainly quite as speedy as any of the West India Mail Company's vessels. Yet the average speed which these last vessels are pre-determined to perform is, in some cases, as high as 10·4 knots per hour, and in no one instance so low as that of the ascertained speed of the Tagus or Great Western. Besides, the times of the mail arrivals should not be the times due to the average speeds but to the minimum speeds; the mails should *never* be late except from some extraordinary stress of weather, or some accident to the machinery. The times allowed for coaling are short enough under the most auspicious circumstances, and cannot be reckoned average times. The directors, in respect of time, have agreed to do more than they can do, or indeed than, with their vessels, can be done; and even were the contemplated speed attainable with the present vessels, it would be highly inexpedient to attain it, as such could only be done at an expense altogether disproportionate to the benefit derived. The consumption of fuel and general expence of maintenance increase with the speed in a wonderfully rapid ratio. The resistance increases as the square of the velocity, the power necessary to overcome that resistance as the cube of the velocity, and the expense in a more rapid ratio still, on account of the increased size and immersion of the ship. A vessel which, at the speed of 6 knots per hour, would only cost 1*l.* per hour for coals, would, at the speed of 12 knots per hour, cost 10*l.* per hour, so that the expense of propulsion *through the same distance* is 5 times greater with the greater speed. To look for an increased speed, then, as any palliation of the existing difficulties, would be preposterous; it would only make the

: so much the worse, even if attainable, by adding fearfully to :pense.

route is badly arranged.—There are too many exact depen- :s and nice reciprocations involved in it, and it is also too :ous. The whole arrangements, indeed, upon this head are so icated as to be scarcely intelligible, and too visionary to be cable; and the utmost confusion appears to have arisen in con- ıce. The movements of this vessel are dependent upon the nents of that vessel, and the movements of this last upon those ıird; so that the detention or occurrence of accident to one of ain breaks the continuity, and throws all into confusion. In this t a transmissive line of steamers is similarly circumstanced to a r operating by stationary engines—an accident at any one of tions stops the whole line. The several stations appear to have ınjudiciously chosen; the grand rendezvous at Turk's Island, the Medina was lost, appears, in particular, to be extremely ble. We tremble at the anticipations of a winter's storms the intricacies and dangers incident to the navigation of these ls—studded as they are with rocks, banks, and islands. The ıny, it is true, has had many disasters, but has not yet had a

vessels are all too large.—Their maintenance is consequently pensive for the trade to bear. The mere expense of engine rages per month is £200 for each vessel, and about as much for sailors, &c.; nevertheless the vessels are inadequately l. The wages and cost of victualling the crews of the several cannot be much if at all less than £100,000 per annum. Taking t of each vessel at no more than £60,000, and as there are or ›e 14 vessels, 60,000 × 14 = £840,000, and adding £60,000 for ·chase of the City of Glasgow and Acteon, as well as the sail- sels, the total capital of the Company embarked in vessels, t leaving them a penny in hand to carry on their business with, just one million sterling. The insurance upon this at 6 per ill be £60,000 per annum, and making the common allowance er cent. for a sinking fund and wear and tear, the amount of m will be £150,000 per annum. The duration of a voyage— the time under weigh from England to St. Thomas, Nassau, ınd by Bermuda back again to England, is in round numbers ed by the Company at 1000 hours, and the consumption per the greater number of the vessels is about 28 cwt.: 1000 × = 1400 tons of coals consumed per voyage × 24 = 33,600 tons :d per annum upon the main line. Adding one half of this :onsumption upon the branch lines and that of the Acteon and Glasgow, the total consumption per annum will be 50,400 tons, :h of this, taking into account the expense of freight, trans- t, &c., will cost very little less than 2*l.* per ton. Adding to :nse of coal that of engine-room stores, viz. oil, tallow, waste, nd red lead, rope yarn, furnace bars, and the numberless ı which every one acquainted with steam navigation as ex- o foreign countries knows to be requisite for the performance rage, the amount of these united items—that is, of coal and hese various engine stores—cannot be less than £100,000 per The number of passengers, sometimes 5 or 6, rarely exceeds : taking 20 as the average number, and assuming that they the greatest distance, the passage money due to which is head, and that the amount of the freight is always equal to ıe passage money, the receipts and disbursements will stand :—

Annual Receipts.

sengers at 62*l.*, less victualling = 46*l.*	£
› × 2 × 46 = 3280 × 24 = ...	78,720
bullion, &c.	78,720
ediate passengers, &c.	10,000
ıoney	240,000
	£407,440

Annual Disbursements.

Wages and victualling crew	£100,000
Insurance at 6 per cent.	60,000
Coal depots	10,000
Wear and tear, and sinking fund	150,000
Coal and engine stores	100,000
	£420,000

Thus it would appear that, at the lowest calculation of expense, supposing that the speed is what the company anticipated, and that the enterprise is better conducted than it ever will be conducted by the present management, the excess of the expenditure over the receipts is £13,000 per annum, and this without the charge of a penny for management, clerks, offices, &c., or a fraction of dividend to the proprietary. So much for the expediency of using leviathan vessels.

We hear that the directors, not satisfied with the havoc they have already wrought, have it in contemplation to establish extensive workshops—to become, in fact, engineers, as the Great Western Company attempted to become. We question the legality of this measure, the funds of the company having been subscribed for a specific object; but, however that may be, we are quite assured of its inexpediency. In the first place, what can a circle of steam tyros know of the management of such concerns? Has their past management been such as to induce the desire, on the part of the proprietary, to embark in a further speculation? In the second place, the contemplated measure would be an act of injustice to engineers, many of whom are extensive proprietors, and who have no right to see their own money squandered in establishing an injurious though unavailing competition with themselves. We presume it was with an eye towards some such measure, that the directors took such pains to have all their engines of a different construction, so that a mould or a spare piece of machinery answerable for one should be altogether unsuitable for another. We must, in this instance, give the directors credit for greater foresight and a more skilful adaptation of means to an end than usually distinguish their procedures; for we must certainly admit that a more effectual method of rendering repairs difficult and expensive, of rendering an infinite assortment of spare machinery indispensable—in short, of rendering it necessary to keep a heavy engineering establishment perpetually occupied, could not have been devised by the most perverse ingenuity. Nevertheless, though much unnecessary expense and inconvenience are thus entailed upon the Company, we do not think it therefore necessary to attempt the mitigation of those evils by the creation of a still greater one; and the directors must pardon us for insinuating, that those persons who already possess the moulds of the various assortments of machinery—who already have workshops, tools, and, what is better than all, who have *skill*—may possibly be able to execute repairs upon more advantageous terms than those who have all of these to purchase. Instead of seeking to squander money in plaster and whitewash, the directors should think of paying some small dividend to the shareholders. Workshops and patterns, though they may cost a great deal, will sell for very little, and there is no proposition more self-evident to us, than that these very estimable *cognoscenti* would very soon *do* for a steam factory, as effectually as they have done for a steam packet company. But so far is it from the intention of the directors to declare a dividend, that we hear it rumoured they intend, in violation of their guarantee, to make a further call upon the shareholders. This call, we are very sure, will be resisted, but that it will be made we are as thoroughly assured; and the best thing the shareholders can do is to at once convene a meeting among themselves, to take the necessary steps for resuming their delegated authority. There are among their number men of cool and clear heads, who well know what steam navigation is, whose advice might do much to retrieve the present unhappy state of affairs, and the shareholders should at once decide upon taking the management into their own hands, until the requisite steps can be taken for appointing another executive. Let a meeting, then, of the shareholders be held; let a resolution be carried, to the effect "that in consequence of the turn the affairs of the Company have taken, the public has lost all confidence in it; and that it appears to the proprietary that the only way of restoring confidence, as well as of promoting the general interests of the Company, is to request the directors to resign; and that with the view of preventing any obstruction to the effectual introduction of a better system, and of giving the public confidence in the reality of its introduction, as well as of advancing the interests of the Company, it is desired that the resignation of the directors should be accompanied by the resignation of all the subordinate officials.'" As men of character and station—which the directors are—they could not refuse to comply with such a requisition; and the Augean stable being fairly swept, let the affairs be put into the hands of the most circumspect, experienced, and energetic persons that can be pitched upon. There may be among the Company's officials one or two persons whom it might be expedient to retain; but no exception should be made on their account. A complete clearance is indispensable to success, and should it be thought expedient, after the new system has been established, to re-elect those persons, it can easily be done, and would then be unproductive of detriment. It is necessary to contemplate the substitution of smaller vessels for some of those at present plying; but this question and all others are comprehended in the fundamental one of efficient management.

In conclusion, we desire to repeat, that for the directors individually we entertain the most unmingled respect; we reverence them as English merchants and as English gentlemen, and we do not believe there is one among them whose high character and general commercial capacity are not universally appreciated and acknowledged. But in their collective character, as the executive of a great enterprise in steam navigation, they are only eminent for their egotistical perversity, and their utter destitution of every qualification indispensable to the exercise of so arduous a function; and we cannot but esteem it unfortunate for their fame, as well as injurious to their fortunes, that they ever assumed a direction of that technical and particular species which their other avocations must have rendered inconvenient, and for which their past pursuits have never rendered them fit. To manage steam enterprises properly requires much skill; that skill is only to be obtained by experience, and such experience the directors have never had. They may, perhaps, have relied for this upon their officials, but such reliance is not a proper one; for what is it but having directors with directors over them? Besides, not one of these same officials has ever had any experience in the conduct of commercial steam navigation upon the large scale, and they are, for the most part, far too theoretical and enthusiastic, to be safe guides or discreet advisers. It is true, time and experience might cure these failings, and in time, too, the directors might acquire sufficient knowledge and discretion to enable them to govern as they ought. But the Company would be ruined in the interim, and by the time these gentlemen had become proficients, there would cease to be a field for the display of their attainments. The particular management ought to be confided to two or three managing directors, who should be paid well for their services, and who should do nothing else. The board of directors should confine itself to the regulation of matters of finance—to the determination of measures of general policy—and to seeing that the managing directors did their duty. That there will probably be some difficulty in getting persons competent to fill the office of managing directors is undeniable, for talent such as that office requires is not likely to be unengaged; yet that eligible persons may be obtained we are perfectly convinced, and no sacrifice should be thought too great to obtain such auxiliaries, the very existence of the company being contingent upon its skilful management.

Let the proprietary then weigh well, proceed resolutely and act promptly. To attempt to disguise their present position would be idle—to shut their eyes to it, insane. We do not think their affairs irretrievable—nay, further, we are of opinion, that under proper management, this enterprise might become as flourishing and lucrative as it is now disastrous and alarming. But this consummation is neither accomplishable by the same measures nor the same men; and the sooner new men and measures are chosen, the less dangerous will be the wound and the less difficult the cure. The proprietary have two courses before them; if they adopt the one they will continue unperplexed and become prosperous—if they persevere in the other they will very soon find themselves embarrassed, impoverished, and undone.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXXVIII.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. If Michael Angelo was, as some have called him, a giant in architecture, he was also a barbarian in it. Many of his buildings are little better than stupendous puerilities; and all of them abound, more or less, with vices that would hardly be tolerated in any one else. Well may Vasari call his St. Peter's "una fabrica *terribilissima*,"[*] it being literally terrible enough in many respects. Memmo has pointed out in his "Elementi d'Architettura," many egregious solecisms in the works both of Michael Angelo and Palladio, and he might have extended the list of them to a much greater length. In regard to the latter, it is, indeed, astonishing that people—or at least some people—should continue to repeat the praises bestowed upon him a hundred years ago, for hardly can it be averred that he now stands in the same relative position he then did. It is also extraordinary that, while Palladio's name has become a metonym for excellence in art, that of Alessi should be comparatively obscure and seldom mentioned at all, notwithstanding that in comparison with him, the other is, at the best, tame and insipid. It is to Alessi that Genoa is mainly indebted for its title of La Superba, and for the stately and picturesque character of its palazzo façades. He has been as much undervalued as his Vicentine contemporary has been overrated. Even his name is not to be found in every biographical dictionary; nor, *horresco referens*, does Woods mention him at all in his "Letters of an Architect," although he says that Genoa may justly be proud of its palaces, which, by the bye, is all that he says about them!

II. A German periodical on the Fine Arts speaks of a house now nearly completed at Paris, for the banker Hope, which is somewhat larger than the Louvre, and when finished and furnished will cost about thirteen million francs! or upwards of half a million sterling! Is this a "Munchausen"? if not, how happens it that no rumour relative to such an architectural undertaking has found its way into any English journal? Had it been a new bonnet instead of a new Louvre, the pattern of it would have been in London in the course of four-and-twenty hours. This, however, is not the only instance of our extreme tardiness in obtaining information relative to what is going on in architecture upon the continent; and about which just as much is known as about the current literature of the continent. For the last twenty years our Anglo-German critics have been pestering us with Schiller and Göethe, Göethe and Schiller, and have gone on Schillering and Göetheing, and Göetheing and Schillering, as if all the rest of the literature were a mere blank. It is pretty much after the same fashion that those who speak of buildings at all, repeat the same cuckoo strain, to the tune of Parthenon and Pantheon, Pantheon and Parthenon, Vitruvius and Palladio, Palladio and Vitruvius, till we sicken of the very mention of them. Who is Cagnola? asks one; and, who is Canonica? who is Gärtner? who is Langhans? who is Rossi? who is Thon? who is Ottmer? are all questions in turn. Truly, there is as yet no railroad for architectural intelligence; it travels as slowly and as crawlingly as an old Yorkshire stage wagon. Perhaps at the end of the century, something will be known here of what has been going on in architecture upon the continent, during the two last decenniums.

III. "It not unfrequently happens that those who derive their knowledge from books are far better acquainted with things or objects than those who have actually beheld them; because he who reads with attention will carefully ponder upon, and reconsider the matter under notice, whereas he who merely looks at things can afterwards give no clear account of them; so far, therefore, reading is more instructive than seeing." Such is the remark of Cervantes in his Persiles and Sigismunda, a work that may be said to be very celebrated, although very little is known; and it is one corroborated by my own experience to a far greater degree than I could wish, for I have again and again found it impossible to obtain any sort of information relative to buildings, from those who have actually seen them. When questioned as to particulars, they tell you they did not notice this, they did not think of looking for that; this they quite overlooked, that they quite forgot to observe; so that what with their overlooking and their forgetting, you find there is no getting any thing out of them. According to their own confession they can describe nothing, nor can they remember any thing; nevertheless, instead of taking any shame to themselves for their ignorance, such people will give themselves airs of superiority merely because they happen to have seen what you have not, and have had opportunities by which they have not in the slightest degree profited. I once amused myself at the expense of a traveller of that description, who was giving me a long account of a building he had visited. Having suffered him to go on without interruption, and letting him have it all his own way, I placed before him a volume of engravings of the building in question, remarking they must be exceedingly incorrect and untrustworthy, since they did not at all tally with his description; in fact they did not agree with it—or rather his description did not agree with them, in any one particular. The consequence was, my gentleman looked very disagreeably astonished at finding himself so completely contradicted by evidence which he could not dispute.

IV. Though I never heard of him before, I am in no danger of now forgetting the name of the nonentity recorded by Nagler as "Philippus, an architect known to us by an inscription in Gruter's work, which says 'Philippus architectus maximus hic situs est.'" Truly there is not much here either to forget or to remember—nothing, certainly, worth knowing; although it is an exceedingly great curiosity in its way, as an article in a biographical dictionary of artists. It is rather too much à la John Britton, who has foisted into his dictionary the names of several such illustrious nobodies as carpenters, stone-masons, and other mechanical geniuses. Surely there is little occasion for peopling dictionaries of artistical biography with such mere ghosts and shadows and sounds, as are Philippus and not a few others who flit before us in Nagler's work, which is already so voluminous in itself, that, like Falstaff, it requires no further stuffing out. In fact Nagler seems to have pounced upon every name he could anywhere meet with, and has accordingly caught and preserved some excessively small fry, people whose names never appeared in print before, except in an exhibition catalogue, or a newspaper paragraph. This is being over-minute and scrupulous, more especially when we find that, notwithstanding such minikin exactness, he has omitted some names of the first magnitude. Will it be believed?—no, it is perfectly incredible—that, while he has given a place in his dictionary to many living architects, and other artists who are either comparatively or positively quite obscure, he has actually omitted that of CHARLES BARRY! This almost beats the anecdote told by Krilov in one of his fables, of the man who, telling a friend all the wonders he had just been examining in a museum of natural history—the shells, moths, and insects there exhibited, was asked by him what he thought of the elephant. "The elephant!—why bless my soul! I did not see the elephant at all!" After all, a parallel instance to that in Nagler may be found in Wolff's account of our English novelists, who, while he notices such bolstered-up mediocrities as Lady Blessington and other namby-pamby scribblers, does not bestow even a single word on Theodore Hook! Utterly incredible, yet positive fact.

V. There is an immense deal of cant in the world besides religious cant, and certainly no little of it infects both literature and art. I have just at my elbow a book where Shakspeare is eulogized in expressions that may be termed blasphemous, the writer observing, as if reproachingly against the poet's contemporaries, that, notwithstanding his unrivalled excellence, he did not obtain from them "a tithe of the loving and reverent admiration we pay to the Creator of a world". This is rather too powerful for ordinary nerves, for when a man writes in such a strain of any other human being, instead of honouring the object of his adoration, he only disgraces himself, and compels us out of mere charity to suppose that he must be quite insane. Much as honest and sincere enthusiasm is to be commended in the literary man and the artist, it has its limits, and if it oversteps them, it becomes either raving madness or drivelling silliness. To hear some people talk, one would really imagine that the Cartoons of Raphael and the Elgin Marbles were the palladium of England—possessions far exceeding in value all its colonies, and its "either Ind." They speak of them as of things holy—as if their loss would be a loss to the entire world, and as if civilization itself would be extinguished whenever they cease to exist. In like manner the enthusiastic admirers of Grecian architecture are apt to speak of it as if the world would never have known what architecture was, or have had anything worthy of being so called, but for the pagan temples of Greece. Grecian architecture is, I own, truly admirable, *as far as it goes*, but then it goes a very little way indeed. Its resources are so exceedingly few—its alphabet so exceedingly scanty—the combinations it admits of are so very, very limited, that we may well be allowed to abate the demands made upon our admiration in its behalf, as being rather too extravagant. Well has it been observed by Göethe, that Grecian architecture may be compared to a clever and intelligent child, very superior, if considered only as a child—as such, perhaps a prodigy—nevertheless not at all equal in capacity to a grown-up person of ordinary mental ability. What Grecian architecture would have ultimately become, had it continued to thrive for ages without check or hindrance of any kind, can now only be conjectured; yet the probability is that it would hardly have advanced at all beyond the point it actually attained. Notwithstanding the poetical nimbus with which classical antiquity has been adorned, the whole constitution of ancient society and civilization was essentially barbarous, because essentially immoral: and could it be otherwise, seeing that their very religion tended to confound all sense of right and wrong, and their deities were little better than so many personifications of vice and baseness—profligate, cowardly, lying knaves and rogues, cuckold-makers, and pimps. A knowledge of the Greek dramatists may serve to recommend a man to an English bishopric, because such has been the case before now; but the reverence paid to classical literature as an element of education has, it may be feared, chiefly tended to keep up a moral taint, so that in consequence of such influence in its higher spheres, "society itself continues selfish, sensual, and belligerent." My pen is just such another unmanageable beast as John Gilpin's steed, for it has run away with me, till I have almost lost myself, and the reader lost his patience altogether.

ON THE SEPULCHRAL MONUMENTS OF SARDIS AND MYCENÆ.

By William Rathbone Greg, Esq.

(From the Memoirs of the Literary and Philosophical Society of Manchester.)

* * It is not uninteresting to observe how generally the monuments, erected in honour of the dead, have outlived those reared for the use or the luxuries of the living. Thus, in the East, we constantly meet with extensive cemeteries, standing alone in a deserted region, where the cities which peopled them have been entirely swept away, and where no human habitation can be found for many leagues. On the plain of Troy, the Tumuli are the only remaining monuments of a time celebrated beyond all others in the history of mankind;—the pyramids of Egypt have long survived the cities of the monarch who erected them;—at Mycenæ, the tombs of the Atridæ may be seen in their original integrity, though their palaces have left no vestige

behind them, and their massive citadel is fast crumbling into ruins;—and of the renowned and magnificent Sardis, the only uninjured relic which has reached our times, is the sepulchre of the sovereign who first raised it into splendour.

To whatever part of the world we turn our attention, we find barrows or tumuli in great abundance, and differing from each other but little, either in construction or in form. They are generally conical hillocks, of larger or smaller dimensions, constructed sometimes of earth, sometimes of stone, in some cases solid, in others containing a vaulted chamber. In our own country they are found in Cornwall, and more especially in Scotland and the Orkneys, where they are known under the name of *cairns;* Dr. Clarke relates having met with them abundantly in the Steppes, or vast plains in the south of Russia;—and I found considerable numbers in Roumelia, both north and south of the Balkan, and also in Servia and Bulgaria. Jefferson (in his "Notes on the State of Virginia,") describes many of them in different parts of the New World; in Africa they are said to be not unfrequent; and in Greece and Asia Minor they are seen in unusual quantities, and of extraordinary dimensions. Having had the good fortune to visit several of the more celebrated of these barrows, it may not perhaps be wholly uninteresting to the Society to hear a short description of the two which most deserve our attention, viz. those at Sardis and Mycenæ.

To commence with the latter. The plain of Argos, in the N.E. of the Morea, is an extensive semicircle of flat, and for the most part, marshy land, situated at the head of the Gulph of Nauplia, and apparently reclaimed from the sea at no very remote period, as indeed mythological history plainly indicates. It is inclosed by a vast amphitheatre of hills, among which is situated Mycenæ, the city of Atreus and Agamemnon, said to have been founded by Perseus, about 1300 B.C. Its remains are very accurately described by Pausanias, who flourished A.D. 180; though Strabo declares that in his time (B.C. 10) no vestige of it existed, and that its site was entirely unknown. It is not, however, easily to be found, even by those acquainted with its general position; for though myself and my companions were furnished with the best maps, and travelled Pausanias in hand, it was not till the second day's search that we were at length rewarded by stumbling upon the Citadel, among the low hills near the village of *Charvati.*

The Acropolis of Mycenæ is a rocky hill entirely surrounded by walls, which in many parts are still tolerably perfect, and, except at intervals, are of the oldest style of Cyclopian architecture. Of the Pelasgians or Cyclopes, to whom all the most solid and stupendous structures of ancient Greece and Italy are, by common fame, attributed, we know almost nothing; nor has the profound and patient genius of Niebuhr succeeded in throwing any material light on the origin, history, or achievements of this singular and powerful people. Their national existence would seem to have been almost terminated before the commencement of the historic era; and many of the most ancient and remarkable cities in Greece Proper and Magna Grecia appear to have been founded by them, either while existing as an independent people, or after their subjugation by other Greek tribes.

It is not my intention to enter here into a description of the massive monuments which bear the Pelasgic or Cyclopian name; but it may be important to remark, that they consist of three distinct styles, which I should conceive to be referable to widely different periods of time. The first, which appears to be the most ancient, consists of walls formed of immense blocks of stone, roughly, if at all, hewn, generally of a square or oblong shape, put together with little care, and having the interstices filled up with stones of smaller dimensions. To this class may be referred the outer walls of *Tiryns*, the Pelasgic wall round the citadel of *Athens*, and a large part of the acropolis of *Mycenæ.* The second style includes those buildings which are constructed of enormous blocks of every imaginable shape, but most commonly pentagons and irregular rhomboids, and fitted together with the most scrupulous and beautiful exactitude. The galleries of *Tiryns*, some fragments which surround the hill of *Argos*, and others near *Arpino*, in the Southern Apennines, are the only specimens of this class I have seen. The third and most modern division of Cyclopian architecture, is of a far more finished and somewhat less massive character; and the tomb of Agamemnon at Mycenæ, which forms the subject of this paper, is, as far as I am aware, the only instance of it extant.

The mystery which hangs over the origin of these massive structures, their singular appearance, and remote antiquity, all conspire to render them most fascinating objects of research. But at Mycenæ our interest was more peculiarly awakened by the celebrated *Gate of Lions*, the entrance to the Acropolis, and the one through which Agamemnon led his army to the siege of Troy. It is formed of two upright slabs of stone, 17 ft. high, and supporting an entablature of similar proportions, viz., 15 ft. long, 6½ ft. thick, and 4 ft. deep, hewn out of a single block. Resting upon this entablature is a triangular slab, 10 ft. high, containing in relief the figures of two lions, standing on their hind legs on each side of a pillar, the summit of which has been broken off. On the whole, it is a most magnificent gateway and on gazing on it, we are at a loss to conceive how, in those remote times, men could have acquired sufficient command of mechanical agents, to raise and place such enormous masses.

About 50 yards from the Gate, and outside the walls of the Acropolis, stands the immense mound, which forms the more immediate subject of these remarks. It is a large, round, conical hill, partly natural, partly artificial, and considerably lower on one side than on the other. On the side nearest to the Citadel an excavation has been made, which succeeded in laying bare the entrance or doorway, a structure of even more gigantic dimensions than the Gate of Lions. On entering this we come into a large vaulted chamber, inclining to the conical form, 50 ft. across at the base, and about 45 ft. high. Adjoining this is an interior chamber of square form, and smaller dimensions.

The chief peculiarity in this beautiful monument struck me as being the extreme neatness and regularity of the masonry. It contains 40 courses of hewn stone, all admirably fitted together, but without cement; and it is, I should think, quite as perfect a specimen of workmanship as could be produced at the present day.

Great doubt exists among the learned, as to *what* this monument really was—some calling it the Tomb of Agamemnon, and others the Treasury of Atreus. Dodwell and Dr. Clarke hold the former opinion, while Col. Leake and the generality of travellers are strenuous advocates of the latter. The only authorities on which we have to rely, are the description of Pausanias, and the plays of Sophocles and Euripides. From the former, it appears more than probable that the Treasury of Atreus was *within* the Citadel; and indeed we can scarcely conceive that any monarch who possessed a fortress as strong as that of Mycenæ, would deposit his treasures anywhere but within its walls. Now the monument in question is *outside* the fortifications, and therefore can scarcely be the Treasury of Atreus. Again; Pausanias places the Treasury near the spring Persea, which in no way corresponds to the position of this tumulus; for the only two rivulets to be found at Mycenæ rise 100 or 200 yards distant. Now we gather from different passages in the Electra of Euripides, as well as from that of Sophocles, that the tomb of Agamemnon *was* without the walls, (although Pausanias seems to indicate the contrary,) for Sophocles describes Orestes as visiting his father's sepulchre before he reached the gate of the Citadel; and in Euripides, when Orestes relates to Pylades his nocturnal visit to the tomb, it is expressly stated that he repaired thither without entering the walls. Now the tumulus in question *being* without the walls, and being also by far the largest to be found at Mycenæ, may fairly be conceived to belong to so celebrated a monarch; and to make assurance doubly sure, we learn from Sophocles that the sepulchre (Ταφοσ) of Agamemnon *was* a mound or barrow (Κολωνη).

I have unfortunately neither the classic lore, nor the habits of antiquarian research, which could alone entitle me to form an independent opinion on this controverted point. Certainly from considerations above mentioned, I incline to Dr. Clarke's view of the subject. But the decision of the question is now of little moment; for whether

If now the carriage with its stylus be moved parallel to itself over the surface of a drawing board, it is clear that any given point of the carriage will describe precisely the same path as the point of the stylus does, and since the pencil is attached to the carriage, this will also be true for it; so that if the tracing point C of the stylus be made to pass transversely across a series of mouldings, and the point be at the same time kept always in contact with their surface, the pencil will simultaneously describe upon the paper the exact form of the section of these mouldings of the same size as the original.

But the surfaces of mouldings are inflected in various directions to the right and to the left, and the tracing point of the stylus must therefore be capable of following such changes of direction. This it is enabled to do by its curved form combined with its power of rotation about its axis; for by turning it, it can be applied at various degrees of inclination, either to the right or left side of a moulded surface, as the form of the latter may require. And as the rotation has been shown not to affect the actual position of the tracing point C with respect to the carriage, so neither can it affect the truth of the section drawn by the pencil.

For example, at C the tracing point is applied to the right of the stone surface, but at X on the opposite side of the rib it is applied to the left of that surface, and is also turned into a different angular position to enable it to enter the hollow. But in passing from X to Y it must be gradually turned into the position shown by the dotted lines, to enable it to clear the projection at Z. In fact, during its progress across a rib of this kind, the point must be carefully watched, and the stylus turned into the best angular position that the momentary form of the moulding requires.

I have said that the carriage of the stylus is always to move parallel to itself, and will now describe the means by which this is compelled.

The base of the machine is a drawing board of mahogany F G (¾ in. thick), 10½ in. by 11½ in., and made to fold in the middle like a book, for the convenience of carriage. When in use it is kept open by a button R on the lower surface. The carriage is guided by a parallel motion somewhat resembling a double parallel ruler, but the proportion of whose jointed arms are altered to suit the different circumstances of its employment.

A plate H is secured to the board by a button-headed screw, K, having a milled headed nut below at L. As K merely enters a notch in the plate H, a single turn to right or left of this nut L is sufficient to detach or fix the plate, together with the instrument, while the slip of metal M, screwed to the board, serves to keep the plate in its proper position.

Two arms N N of equal length are jointed to the extremities of H, and also to an arm P of the same length as H; consequently P will be parallel to H in all positions. Two other arms Q Q, also of equal length, are jointed at one end to the arm P, and at the other to the carriage of the stylus, so that the latter will be parallel to P in all positions, and consequently to H. This arrangement enables the carriage to move freely and steadily from one side of the board to the other, and over every part occupied by the paper, and at the same time keeps it always parallel to the plate H. The paper T S, upon which the mouldings are to be copied, is secured to the board by a pair of spring catches V, W, of which the last is placed near the corner S of the paper, to prevent the latter from being caught and turned up by the arm N of the instrument during its motion.

It is absolutely necessary that the board of the instrument should be held steadily, in the same position, against the mouldings during the process of tracing. The two retaining pieces *a c*, *b d*, are provided for this purpose; these are attached to the lower side of the board by thumb-screws, *e*, *f*. In Fig. 3 they are shown in the position requisite for closing the instrument, but in Fig. 1 they are in the position for use. When the thumb screws are relaxed, either of the retaining pieces may be drawn out, and turned to the right or left so as to touch some convenient projection of the moulded surface, and thus when clamped fast, to retain the instrument in the same position so long as it is pressed into contact with the mouldings.

This adjustment of the retaining pieces must always be made previously to taking the profile of any mouldings; the board must then be grasped in the left hand at O, and held firmly against the mouldings. The button at D is managed by the right hand, which will be found sufficient as well to guide and turn the point of the stylus as to keep the pencil in contact with the paper, and to raise it off the paper when necessary, which the elasticity of the parallel motion will allow of easily.

Fig. 4 is a section of the edge of the board at W, to show the form of the paper springs. These, which are also seen at *h k*, *h k*, Fig. 3, are screwed to the lower side of the board in sunk recesses, and are released from the paper by pressing them at *k*. When the plate H, with the parallel motion and carriage, are detached from the board, they may be deposited in a recess sunk for the purpose on the lower surface, as shown at *l m*; the button R is then to be turned into the position shown by the dotted lines, and the board may be folded together, and secured by a hook in front. The recess at *n* receives the stylus, and those at *s*, *s*, *s*, receive the milled nuts *e*, *f*, L, respectively.

When a series of mouldings are to be copied which exceed the limits of the paper, they must be taken piecemeal, as shown at Fig. 5. This figure shows how the entire rib of Fig. 1 may be represented, which rib is too large to be entirely comprehended within the boundaries of the paper. In this and similar cases it is better to apply the instrument against the right and left faces of the rib in succession. In the first operation the mouldings from *o* to *p* (Fig. 1) will be taken, and in the next operation those from *q* to *v* (the same letters are employed in Figs 1 and 5).

Care being taken always to draw an overlapping portion of the mouldings in the successive drawings as in this case from *q* to *p*, there will be no difficulty in joining the separate pieces into one continuous line by tracing them on a larger sheet.

A small black-lead pencil and common paper may be used for the purposes of this machine, but as the point is very liable to break and become troublesome, I find it much more convenient to employ the *metallic* paper, which is prepared by Messrs. Harwood, 26, Fenchurch Street, and requires only a brass or other metallic point instead of black lead. Besides this advantage, the trace is indelible. The paper for the instrument should be cut to the proper size, and carried in a portfolio. By a somewhat different arrangement of the instrument, the paper might be made to remain always in its place on the drawing board in the form known by the name of a *block*, from which the sheets are to be detached as fast as the drawings are made. This would increase the size of the machine, however, by making it exactly as large as the paper, and the folding hinge would be placed in a direction transverse to that which it occupies in the present design.

This instrument requires no great accuracy of workmanship. The two essential points upon which the precision of its action depends are, 1st, that every pair of arms N N, Q Q, of which the parallel motion consists shall have exactly the same distance between their joint holes. This is easily secured by drilling them all separately, from a pattern arm made previously. Similarly the holes in the plates H, P, and the carriage, must be at the same distance respectively. 2nd, that the point of the stylus shall be in the axis of rotation. This is also easily effected, and is as easily verified at any moment by twirling the stylus in its carriage opposite to a fixed point.

The parallel motion may be made of thin slips of sheet iron rivetted together, but better of sheet steel. The hinges of the board must be so placed that when it is closed or folded, there may be room between its inside surfaces for the retaining plates *e f* and the button R, which must be made all of sheet iron or brass of the same thickness.

The length which I have given to the arms of the parallel motion, is just sufficient to allow the pencil to travel over the board. The limit of the motion to the right will be found to be that the arms Q Q will come into contact, and thus prevent farther motion in that direction; and similarly the limit to the left will be the contact of the arms N N. If the size of the instrument is increased, the same proportions must be preserved between the arms and board.

R. Willis.

Cambridge, *June* 10, 1842.

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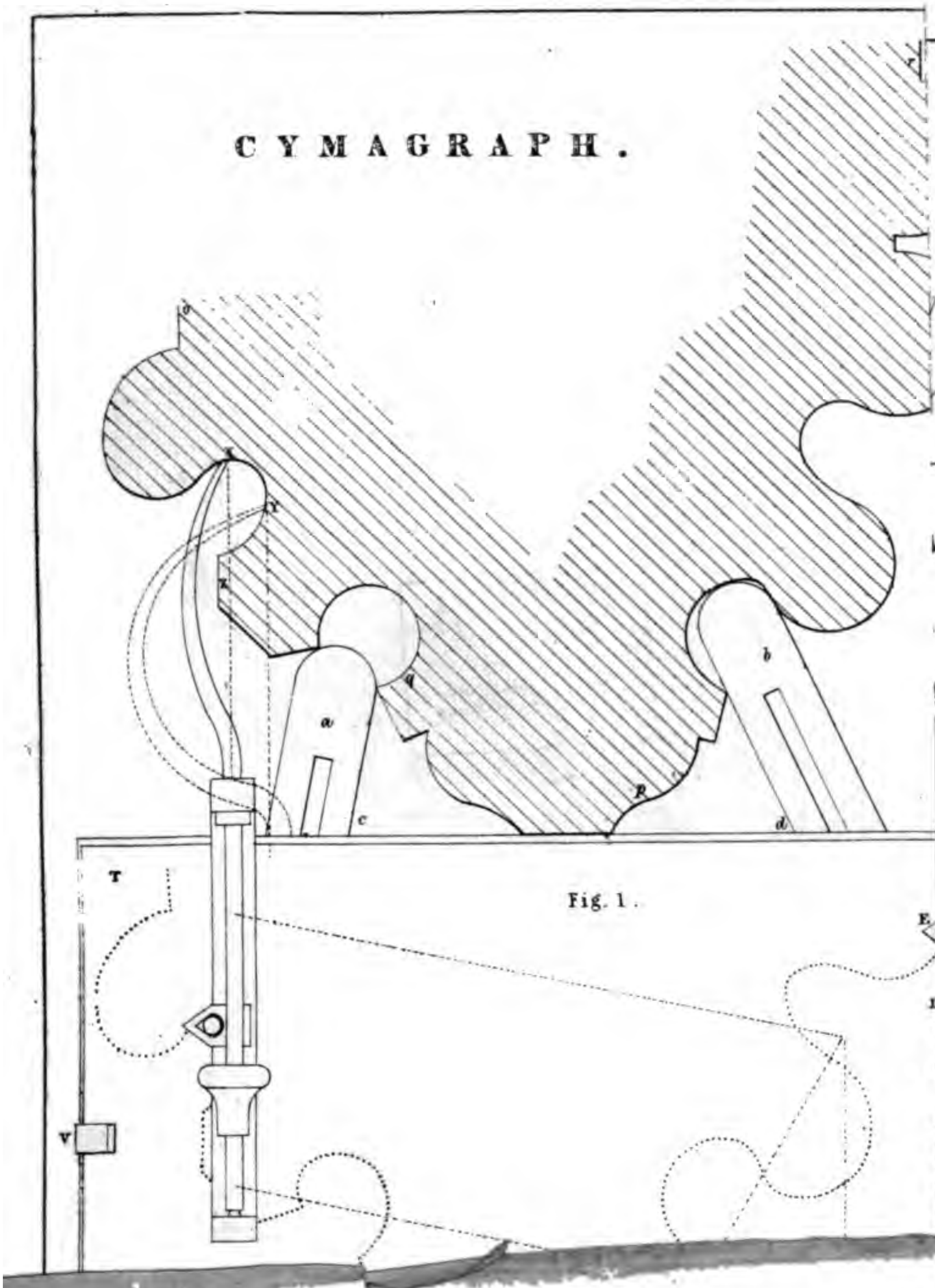
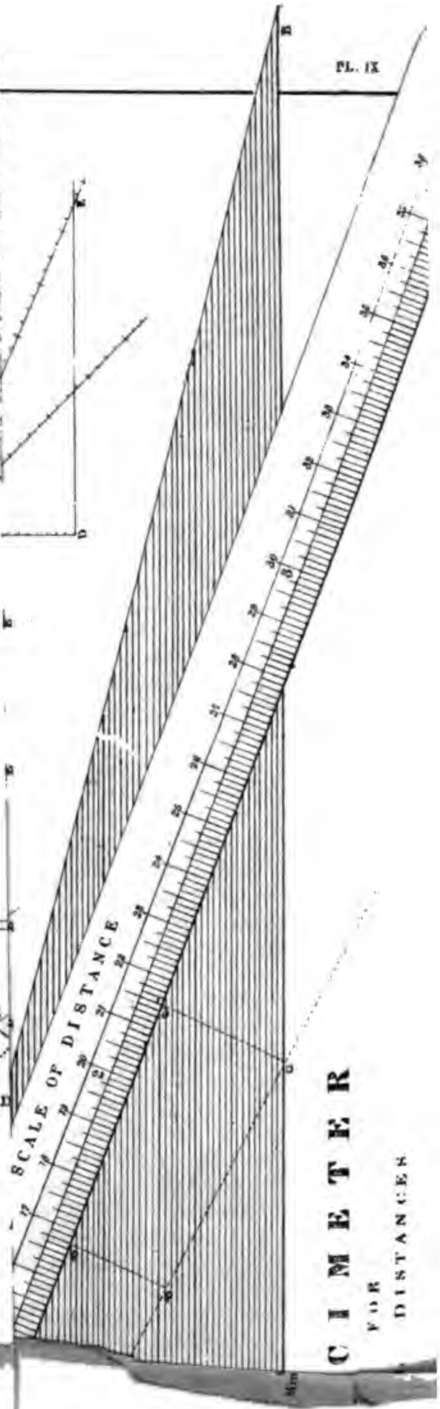

CYMAGRAPH.

Fig. 1.



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piece may be drawn out, and turned to the right or left so as to touch some convenient projection of the moulded surface, and thus when clamped fast, to retain the instrument in the same position so long as it is pressed into contact with the mouldings.

This adjustment of the retaining pieces must always be made pr

tion; and similarly the limit to the left will be the contact of the a N N. If the size of the instrument is increased, the same proporti must be preserved between the arms and board.

R. WILLIS.

1842.

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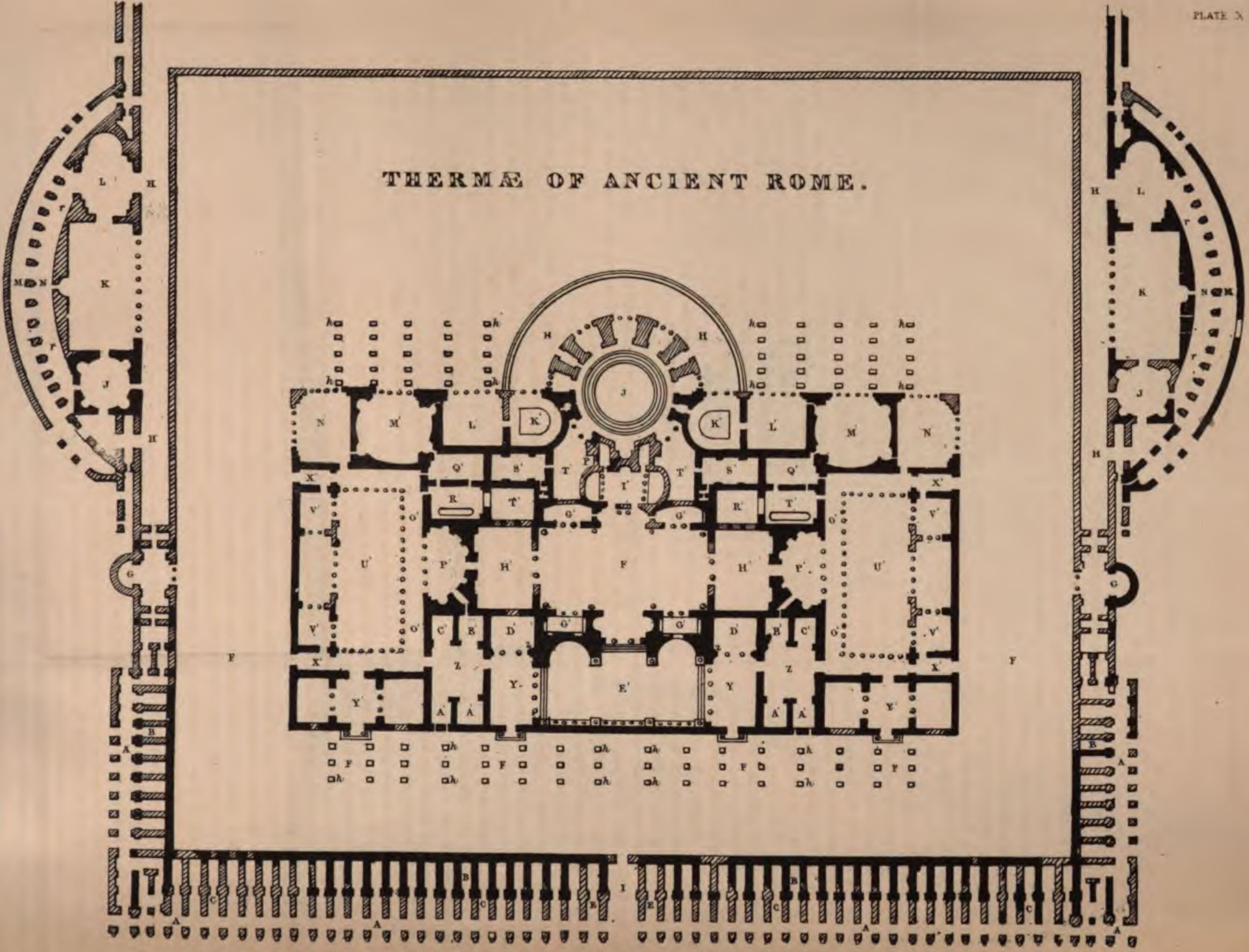
PLATE X.

THERMÆ OF ANCIENT ROME.



ON THE THERMÆ OF ANCIENT ROME.

(With an Engraving, Plate X.)

Extracted from a Paper read by the REV. RICHARD BURGESS, B.D. *Honorary Member, at the Royal Institute of British Architects on Monday, 30th May,* 1842.

* * * IF, as I have before observed, we learn from the study of temples much of the religious rites of antiquity, if from the Basilicas something of the mode of administering justice, if from theatres and amphitheatres the public sports and pastimes, if from circuses and stadia open air exercises and recreations, all which I have attempted on former occasions to make out, with a little topography by way of light reading!—from the Thermæ or public baths of Rome we may learn something of that "luxuria sœvior armis" which finally overcame the courage of the Quirites and the modesty of the Roman matrons.

It will not answer any purpose except that of tiring my audience, to investigate the state of swimming and bathing in ancient Greece; and unless Scipio could be shown to have been particularly hostile to ablutions, I do not see why classical writers should make it such a wonder that he had a bath. Seneca saw the remains of Scipio's bath at his villa at Liternum, which he calls a "balneolum angustum tenebricosum," which may be translated 'the black hole of Calcutta, filled with hot water.' "But who," the moral philosopher asks, (after having described the darkness of Seneca's blattarium,) "would endure to bathe in such a place now? In short," he adds, "we have got to that pitch of refinement that we cannot even put our foot upon anything but gems." Leaving, however, the Greeks to bathe in the sources of the Xanthus, and the Romans of the republic to lave their hardy limbs in the waters of old Tiber, we will proceed at once to the period when the luxury of the warm bath began to be publicly enjoyed at Rome. I shall first give you a *catalogue raisonnée* of the thermæ from the Augustan age to the reign of Constantine, and then proceed, with the help of our architectural illustrations, to describe the different parts and uses of the edifice, noticing as I go along the variety of occupations for which the thermæ were destined.

Agrippa was the first to teach the Roman people the indulgence of the warm bath. The thermæ which he erected in the Campus Martius were bequeathed to the public, and they were embellished, according to Pliny, with various works of art. Amongst the statues was the bronze youth in the act of undressing, called the Apoxyomenus, a work of Lysippus, of surpassing beauty. Some remains of the thermæ of Agrippa still exist immediately behind the Pantheon, and extending, with interruptions, to the large fragment of a vault called, from its resemblance to a crown, the Arco della Ciambella. Those baths had only the *corpus internum*; and except the *sudatorium laconicum* mentioned by Dion Cassius, we are unable to trace by the vestiges that remain, any of the usual compartments of a thermæ establishment. It will occur to many who now hear me, that the Pantheon, when stripped of the inimitable portico, and opened at the large tribune facing the entrance, would be reduced to nothing more than a principal hall belonging to the baths, very much resembling, both in form and position, the round room to which I shall have to refer in the thermæ of Caracalla (see ground plan of Pantheon). I believe it must be allowed (however shocking to our classical tastes and feelings,) that the portico of the Pantheon was an afterthought, and that the magnificent cupola was originally intended for the large hall of Agrippa's thermæ. Of the baths of Nero and Vespasian we know nothing, except that the former, *Balnea Neroniana*, are mentioned by a poet of the fifth century as being adjacent to the thermæ of Agrippa.

The next great baths erected at Rome were by Titus: they were built over the ruins of Nero's overgrown palace, and their vast remains still cover a good portion of the Esquiline Hill. The well-known plans and illustrations of De Romanis will render any farther description here superfluous (see plan). I may, however, observe that, taking a measurement of the thermæ of Titus, and guided by the indubitable vestiges remaining in the several vineyards and lanes around, the whole space occupied by the buildings must have been three-quarters of a mile in circumference. I am not aware that any description or any account whatever has reached us of those immense thermæ: the ruins themselves are the mute historians of what they once were, and it is from the subterraneous vaults containing the celebrated arabesque paintings that we learn that the house of Macænas, embodied in the palace of Nero, formed the foundations of the area on which the thermæ Titianæ were erected. Those baths were built at about the same period as the Flavian amphitheatre: the reservoir, called the sette sale, for supplying the water, is still to be seen.

If we consider the thermæ of Agrippa and balnea Neroniana as parts of the same establishment, we may equally annex the thermæ Trajanæ to those of Titus, making *two* large public baths; and except the balnea and lavacra of a more private kind, these were all that serve to indicate the progress of luxury during the reign of the twelve Cæsars and their two immediate successors, which brings us to the 120th year of the vulgar era. Considerable remains of the thermæ of Trajan (which were probably begun by Domitian to complete the work of his brother,) are to be seen beneath the church of S. Martino ai Monti. We are indebted to ecclesiastical writers for a notice of these baths: they were the scene of two councils, in which the heresies of the third and fourth centuries were condemned; and although they are to be considered as a continuation of Titus' works, yet they retained in later ages a distinct appellation. The thermæ of Hadrian were a still further addition, or perhaps the completion and embellishment of the works of his predecessors might cause the name of that imperial architect to be inscribed on the walls. Two statues of the young Antinous were found amongst the ruins; and perhaps this circumstance has chiefly prompted antiquaries (who sometimes snatch at shadows,) to put Hadrian's name into the list of builders of baths. If, however, the thermæ of Titus were begun by him, carried on by Domitian, and achieved by Trajan and Hadrian, the work must have been in progress from first to last for about 30 years. If we except the thermæ publicæ, the position and extent of which have not been ascertained, we go through the second century, including the golden age of the Antonines, without any further increase of those luxurious establishments. At this period (dating from the reign of Commodus,) historians generally date the period of the decline of the Roman empire; and from this same period the great increase of thermæ began. It was during the *third* century that those prodigious edifices were reared whose remains are to occupy our attention this evening. The first are the Thermæ Antonianæ, built in the reign of Caracalla, and finished by Alexander Severus. This immense structure was begun in the year 205 or 206, and was finished with the exception of some outworks added by the successors of Caracalla, before the year 217. In the excavation made by the Conte Velo di Vicenza in 1826, a fragment of marble was turned up, on which were read in ill-formed letters the names of Albinus and Æmilianus. As this fragment of marble appears to be unworked, one would conclude that it is as it came from the quarries, where it was not unusual to scratch the names of the consuls for the year upon the surface of the blocks. We are thus enabled to say that in the year 206, when the two consuls named were in office, the materials were preparing for the erection of the thermæ near the via Appia. They were situated near a valley which divides the Aventine mount, and in which formerly were the Piscina Publica. It will be seen, by reference to the plan, that they were nearly a mile in circumference, including the exterior porticos, and it may be imagined what the riches of this fabric were, from the profusion of marble and the exquisite works of art which at different periods have been found; 1600 seats of polished marble furnished the interior of the apartments, and the Cella Solearis, to which we shall shortly recur, was the wonder and admiration of all architects. The ancient authors have left us scarcely any description of those baths, but they almost seem at a loss for words to express the splendour of the building. The seven-leagued word of "magnificentissimas" and "thermæ eximiæ" are found in Spartian. Eutropius calls them an "opus egregium," and when we find vestiges of tesselated pavement on the topmost stairs, where the attendants had their lodgings, we may judge what the rooms below must have been, for the reception of emperors, senators, knights, and the Roman people. There were also in this same region some thermæ erected by the emperor Decius about the middle of the third century. We are also made aware of some thermæ of Philip by the fragment of an inscription, and we know from Vopiscus that Aurelian built baths in the regions beyond the Tyber. But the next great wonder were the prodigious thermæ of Diocletian, erected towards the close of the third century. Scarcely any mention of this stupendous fabric is to be found in any of the ancient writers whose works are extant. The story that forty thousand Christians were made to work like slaves in rearing the building, rests upon very slender authority; but if it were so, they might have been consoled with the reflection that they were only aiding to erect a Christian church, for one of the most splendid basilicas of Rome is now formed out of the ruins. We shall shortly recur to the remains of those baths when we come to description. The next and last edifice erected in ancient Rome for this purpose were the thermæ of Constantine, probably about the year 325. Considerable remains of these exist on the Quirinate Hill, adjoining the Colonna Gardens: Sextus Aurelius says they were not inferior to the other. The two colossal equestrian statues now on the Monte Cavallo, the bas-reliefs and busts, as well as the fresco paintings kept in the Ruspigliosi Palace, all came, as it is most probable, from those ruins. The three statues of Constantine and his sons (two of which now stand on the balustrade of the Campidoglio), and above all the inscription which relates that a præfect restored those baths to their pristine splendour, prove that we are right in identifying those ruins with the name of Thermæ Constantinianæ. The remains now visible are used for hay lofts, and are not sufficient to enable an ordinary observer to form any idea of their plan or extent. Nevertheless the creative genius of Palladio and Serlio has attempted the task of restoration, and it is not for me to cope with such high authorities, of whom, as well as of the baths they illustrate, it may be said to their immortal honour, stant nominis umbræ.

We have now run through the catalogue of thermæ which were erected at Rome during the first three centuries of the Christian era, and there is no reason to suppose they were not *all* existing when Constantine added those we have just mentioned. Publius Victor, in his regionary or catalogue of public buildings, made about the year 360, enumerates all the great thermæ we have mentioned as then existing; and under the same head (together with Lavacra) reckons up a total of fourscore. Besides these, there were the balnea in private houses, the nymphæa and lacus in gardens, and the aquæ sanatariæ, more or less used for bathing; and such was the accommodation for the luxury of cleanliness, that not an inhabitant of Rome, unless he decidedly preferred it, need have continued unwashed, for in the public establishments a bath might be had for the smallest piece of money coined at Rome* But our wonder will be increased at the magnificent luxury of the Romans, when we have made ourselves acquainted with the different parts and uses of a thermæ establishment, which I now propose, according to my slender means, to point out to you.

Description.

All the thermæ, as far as we have the means of ascertaining, had the same aspect, and with very little variation in the distribution of their parts. It will be seen by reference to the plan of ancient Rome, that the three great fabrics of that description, which in part remain, have had their principal elevations towards the south-west: by this arrangement they secured the means of providing summer and winter apartments, as they did in their large villas. The space occupied by the thermæ was nearly a square: in the case of Caracalla's each side measured 1100 feet; of Diocletian's about the same; of Titus' something less. Attached to each was a castellum aquæ or reservoir, divided into compartments, and supplied by an aqueduct, so that an abundance of water was always at hand for the purposes of the establishment. In Diocletian's and Titus' baths those reservoirs were detached from the main building; in Caracalla's it served as the back of the theatridium, while the immense thickness of the walls prevented all inconveniences. On each side of the theatridium, where the spectators sat to view the exercises in the arena, was a palœstra, (K) which, according to Vitruvius, ought to be a peristyle, either square or oblong. In these, gymnastic exercises were performed in the winter months, and on either side of those were rooms destined for the attendants or balneatores; those at the end (O) have upper stories, and the stairs cut in the walls are still to be traced. The same disposition may be observed in the baths of Diocletian, and something similar, though much less perfect, in the Thermæ Titianæ. I have said that the place in front of the theatridium was the arena for exercises in the open air: the ample space lying between that and the principal elevation was the grand xystus (Q) or pleasure-ground. The xysta, Vitruvius says, ought to be made so that, between the porticos, there may be groves and rows of plane trees. Walks, he adds, (ambulationes) should be laid out among the trees, and places for repose (stationes) should be made of opus signinum. A similar space, though inferior, lies behind the north-west elevation (F), and this I take to have been the minor xystus, where the lower orders of the people were permitted to have free access, and might extend their perambulations on each side of the nine peristyles. Vitruvius speaks of xysta in the plural number, and I think by comparing the plans of the other thermæ, it is evident that each was furnished with a major and minor xystus, observing that distinction of classes for which equality men are in all ages so remarkable, but which we can adjust without any odious comparisons, by having our xystus major at the end of Picadilly, and our xystus minor somewhere about'the Tower Hamlets! But to proceed with our outworks: it is generally supposed that the two large hemycylia, one of which remains almost entire as to its ground plan, were added by Heliogabalus. They contained, first a palœstra (K), communicating with rooms (L) or scholæ where, in all probability, philosophers delivered public lectures, and with some square compartments (J), which we would designate academies for holding discussions. The open walks (N) are Vitruvius' hypœthræ, and they communicate with the covered Ambulachra, which were not unlike the cloisters of a monastery. Here the students and philosophers could take their exercise in undisturbed meditation, and repass at pleasure into the long hypæthræ ambulationes (H) which, according to the Vitruvian precepts, ought to join the xystus. In other thermæ the two sides of the square wanted those magnificent hemycyclia, and had more of the exedræ, like (G); they were furnished with seats for *conversazioni*; in Dioclesian's baths such recesses were numerous. The fourth side of the exterior works, turned towards the via Appia, presented a splendid elevation, as may be well conceived from the illustration of M. Blouet. There are sufficient indications of this lower series of compartments having been used for baths, and I rather think that these were dedicated to the use of the common people, who might pass from them into the minor xystus. There were not less than fifty separate baths, each with its ante-room (C), where the bathers might undress, and from whence they might ascend by staircases to the higher parts of the building, or pass into the portico, which continued the whole length of the front. The elevation consisted in two rows of arches supported by columns, and surmounted by a balustrade ornamented with statues. The spectator, in viewing this front from the via Nova, (a street made when the thermæ were erected,) saw the stately trees of the xystus waving their luxurious foliage above the balustrade, and the dome which covered the pinacotheca rising majestically over the whole; and after approaching the vestibule (I) in the middle of the elevation he ascended into the xystus, and betook himself, as we shall now do in imagination, to the interior of the fabric.

It will be remarked, by a slight reference to our ground plan, that there are duplicates of all the rooms and peristylia, and that the middle space is occupied principally by three large compartments, the first (J') girt with the spacious hypæthræ (H), has been a circular room not unlike the Pantheon if stripped of its portico. This is supposed to be the *caldarium*, and being exposed to the sun, received much of its heat therefrom; to which the hypocaustum or place for heating water being adjacent, or underneath, gave additional warmth; in the midst was a circular reservoir, in which the bathers took their exercise together, the spectators, leaning on a barrier, were admitted to the suffocating sight. Any one who has seen the large baths in Turkey may form a correct notion of a caldarium. I allude now especially to the baths at Brousa, in Bythinia, at the foot of Mount Olympus, where I have seen this process of hot bathing, and where the Turks seem to enjoy swimming in water heated to a degree which would certainly boil a Christian or skin a Jew. After the process of scalding, it must have been grateful to the sensations to pass back again into the next room (I′), which was the tepidarium; in this also there was room for swimming about, and after this *(in the returning process)* the bathers passed into the large room, which is the second of the three mentioned, and which was the cella tepidaria; here in four recesses were deep and ample basins (G′), discovered in the excavations of 1826 to have been lined with marble, with the steps for descending into them existing; in the centre of each side were two immense circular basins called Baptisteria, and which are probably those now standing in the Piazza Farnese; this spacious apartment (F) with the rooms (H) at each end, measures 300 feet by 100, and the centre portion of it was supported by eight immense columns of granite, and must have been the most imposing saloon in the whole establishment. Taken in its whole extent, we conceive this to have been the pinacotheca, which the ample room now formed into the church of Sta. Maria degli Angioli, at Diocletian's baths, resembles. The third great compartment no one doubts was used as the natatio or cold swimming bath, called also the frigidarium, and sometimes piscina, because originally a large basin of cold water or a lake, where fish were kept, was so called; this too was supported by 8 columns, not inferior to those of the pinacotheca. At each end were the vestibula (Y), and the Apodyteria (Q′), and the rooms (A′) where the Capsarii took care of the clothes, and the corresponding places B′ C′, where the Aliptæ and Unguentarii were ready to anoint and perfume the bathers, and the rooms D′ called Diætæ, where they might have refreshments. By this arrangement, the bathers who desired to go through the whole process of a purification, might pass from the cold natatio facing the north to the caldarium facing the south, and return again by the same gradations of heat and perspiration, until they were ready for a repast or a repose, or a conversation in some of the numerous apartments. Such were the rooms (R′ T′) and perhaps others that might be reached by ascending to the second story;* now either the large room (J′) or (F′) must have been that famous cella solearis mentioned by Spartian, and as the middle room, holding the most prominent place in the whole plan, appears to unite all the properties necessary to meet the description, I have always been of opinion (before I had the satisfaction of finding M. Blouet agree with me) that the pinacotheca was the cella solearis; I do not think it necessary, however, to stand out for the heat of the sun, for antiquaries yet differ upon the word solearis, and the room, as far as the epithet goes, might either be called from the sun or from the lacing of a slipper; the remarkable feature of this cella solearis was the working of the roof; it appears to have been fretted or cancellated by copper lacing over a vast extent of space, in such a way as to render both its design and execution a matter of astonishment to artists; if the large central room which I have designated the pinacotheca was the cella solearis, then its magnificence would be increased by the works of art which were placed in it, for such rooms in the public thermæ became as many national galleries where paintings were deposited (as the word pinacotheca implies), and other specimens of art which the authors thought fit to expose. The space was so ample that it was not necessary to make previous application for a good place, and the admission being gratuitous, the connoisseurs paid more than one visit, and found out the good picture or statue in the most obscure places. Our attention is yet to be called to the two large open peristyles (U′) in which the athletic exercises were performed, as the Mosaic pavement opened in 1826 indicated, for in the semicircular recesses (P′) were represented full figures of Discobuli, some with their names written near them, others with the wreath of conquest in their hands. The hemycyclia (P′) were used for the visitors of the sports, and the separate divisions (V′) were probably schools or ephebia, where the youthful arms were practised in manly exercises. We have now only to finish the principal façade of the xystus. On each side of the caldarium (or circular room in the middle) is a comparatively small basin (K), and these I take to be the sudatoria, one for the men and another for the women. By a passage from these we enter into two square rooms, which are suitable for the vestiaria, and may be considered as the apodyteria for this more dignified part of the baths. The rooms M′ and N′ may fairly be assigned for gymnasia in fine weather; the corner apartments (N′) are open on two sides, and lead into the xystus; to complete our idea of this once splendid building, we may look at the restored elevation of this façade by M. Blouet, which, after what has been said, we can hardly believe to be over-wrought or exaggerated in ornament.

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* ——————Dum tu *quadrante* lavatum,
Rex ibis. *Horat. Sat.* i. 3.

I may not lengthen this paper by attempting to speak of the construction and materials of this ancient edifice; the quantity and quality of its decorations may be inferred from the noble specimens of art that have come out of its ruins; the Farnese Hercules, the Glycon, the Bull, the Torso Belvedere, the Atreus, are too well known to need repetition. The treasures found and carried away by the nephew of Pope Paul III. were enough to have formed an interesting museum of antiquities; the Flora, the two Gladiators, and a quantity of busts were among them. The granite column now standing at Florence attests the magnitude of the pinacotheca from whence it was taken; and yet all we know is perhaps but a fraction of the rich art with which those thermæ were embellished. When we consider the immense provision made for bathing in ancient Rome (for there were seven or eight great thermæ at one time existing), the practice must have been diffused throughout the whole population. As early as the Augustus, a poor man might wash for a farthing, and little boys (Juvenal intimates) paid nothing. But the practice, which at first was wholesome and of public utility, afterwards degenerated into effeminacy and indolence. The Emperors promoted the abuse of the bath by their example; Hadrian bathed in public with the lowest of the people. But it is a consolation, to know that those splendid edifices were not erected solely for the sordid purpose of bathing; by reference to our ground plans we shall see that but a portion of the whole thermæ was dedicated to that object; we may leave the motley throng in the frigidarium, pass by the half naked groups in the cella tepedaria, and say nothing about the delights of the sudatorium, or the boiling process of the caldarium; the filthy and effeminate we may enclose within the limits of the three large centre rooms; but all the rest of the space was dedicated to nobler and more manly purposes. The whole must have presented an animated scene, and the magnificent display of works of art appears to have compensated in some degree for the disgusting exhibition of works of nature. In the peristyles were the competitors for a laurel crown exerting their muscular strength, while poets and philosophers sat looking on in the recesses of the exhedræ; there a public orator delightens an intellectual audience with the flowers of rhetoric; in the walks of the xystus wandered in groups the sons of Apollo, while the notes of the lyre resounded from behind some shady plane tree; parading in the hypæthræ were senators and politicians, and in the more retired ambulachra the students of Plato's or Aristotle's philosophy; in front of the theatridium the foot race was run, and the applause which saluted the man who won, rung through the stately arches of the adjoining hemycyclia; in the terraces of the upper story were companies of idle but witty spectators, looking down upon the passengers moving along the Via Appia, or espying from afar the approach of a governor returning from his province. A thousand occupations of pleasure and recreation were carried on within the walls of the lofty apartments, which were covered with all the variety of colours and costly material, where the Egyptian granite was incrusted with the green, yellow and red marbles of Numidia. In the midst of this splendour might have been seen a swarm of dirty and ragged plebeians criticising the painting and statues of the pinacotheca, and although they indulged in gross and vulgar sensuality, could display a taste in works of art which our modern populace might envy. In winter as well as in summer those places of public resort were open; the soft climate of Rome required no fire to warm the room with a southern aspect, and the fountains which played in every direction refreshed the very air in the hottest season. This description is not only applicable to the thermæ of Caracalla, but also to the others whose ruins still exist, and cover almost an equal space. Indeed, if we may credit Olympiodorus, the baths of Diocletian had more than 3000 seats of polished marble. Nor have we yet mentioned all the apartments and their uses which a thermæ establishment contained; we have assigned no place for the conisterium, where the athletæ were sprinkled with dust, that the antagonist might hold him the faster; no place for the elæotherium where he was besmeared with oil, that the hold might be slippery; there was the sphæristerium or tennis court; the bibliothecæ, the coryeæa, the musea, must all find a place; but I have not attempted to fasten a name upon every compartment, just for the sake of filling up the plan. Let it suffice to have enumerated the parts and uses of a thermæ, and with the help of other men's labours to have illustrated one of the principal causes of the decay of the empire. It is thus, gentlemen, that we learn, from the labours of the antiquary and the architect, what the historian has passed over in silence, and we are enabled, with these plans of the ancient thermæ before us, to account for the facts which the historian has recorded, viz. that the valour of Rome sunk ingloriously before the vigorous arm of the barbarian. It was when Vitiges, the king of the Goths, cut off the supplies of water in the fifth century, that the thermæ began to be deserted, but not before they had been one of the most powerful causes in bringing those Goths to the walls of Rome. If a society for the suppression of vice had arisen in the age of the Antonines, the plague might have been stayed; but in the absence of moral and legal restraint, vice was promoted and activity of body destroyed; and it might have been said with truth of the motley crowd in a thermæ,

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* M. Blouet, however, designates the room (R′) sudatorium, applying some directions of Vitruvius a little too vaguely.

"Non his juventus orta parentibus
Infecit æquor sanguine Punico."

But in making some practical application of this subject, I would observe, in conclusion, that it does not follow, if we could have some such public establishments now, that the same evils would arise; with our experience of past ages, and with that leaven of morality which the influence of a pure religion has introduced, it might be possible for us to adopt all the advantages of the thermæ without their mischief; their cleanliness and health-promoting exercise without their effeminacy, their means of recreation without their idleness, their useful resources without their foolish luxury.

"Think'st thou there is no tyranny but that
Of blood and chains? the despotism of vice,
The weakness and the wickedness of luxury,
The negligence, the apathy, the evils
Of sensual sloth, produce ten thousand tyrants,
Whose delegated cruelty surpasses
The worst acts of one energetic master."

To this the thermæ of Rome bear witness, and therefore our thermæ may not resemble those. * * * *

Iron Wire Bridge.—It is strange that the plan of making bridges of iron wire, so successfully adopted in Switzerland, France, and elsewhere abroad, should not yet have found favour enough in England to be fairly tried on the large scale; the noble bridge at Freyburg, in Switzerland, is 301 feet wider than the Menai Bridge, and though it consists of one span, it is at least equally strong, and cost only a fifth part of the money. The wire bridge of Freyburg is 870 English feet span; that of Menai 569. The Menai bridge cost 120,000*l.*, that of Freyburg, 25,000*l.*—*Patchwork, by Captain Basil Hall.*

ON THE PRESENT STATE OF COLOGNE CATHEDRAL, AND ITS PROPOSED COMPLETION.

"They dreamt not of a perishable home,
Who thus could build." ——

The cathedral of Cologne, if completed as proposed by the powerful mind which designed it, would probably be one of the most wonderful and beautiful monuments of the skill of man in the whole world;—its enormous size, the elegance of the details, its completeness as a whole, would alike strike the beholder as unequalled and surprising. Cologne, although as Coleridge says,

"———— a town of monks and bones.
And pavements fanged with murderous stones,
And hags and rags and dirty wenches!"

in which he counted seventy *stenches*, may be termed the Rome of this side the Alps, containing more objects of interest to the architectural antiquary than any city in this position that I remember. Foremost amongst them all, however, is the cathedral, even unfinished as it is. No one who has seen it will easily forget the effect produced by it, or cease to desire that it should be worthily completed knowing as nearly all do know, that by a series of lucky accidents that some of the original drawings are preserved to us. The designs for the principal front, which it seems were formerly kept, one with the archives of the cathedral, and the other in the masons' lodge, were lost when the French occupied the city in 1794. In 1814, one of the drawings, namely that which represents the north tower, was accidentally discovered in a corn-loft at Darmstadt, by a decorative painter who was about to occupy the loft as a studio. Being drawn on parchment, it had been used for many years as the bottom of a sort of tray in which to dry beans; but with the exception of the marks left by the nails which fastened it to the wooden rim, and a fracture in the lower part of it, was little injured. It fortunately came into the possession of Dr. Möller the distinguished architect, of Darmstadt, who published a fac-simile of it in 1818. At the time of the discovery of this drawing, M. Willemin was publishing his work "*Monuments Français inédits*," and Dr. Möller was struck by the analogy which appeared between the style of a large window represented in the 12th No. of that work, and that of the details of the tower at Cologne. He mentioned the circumstance to M. Boisserée, who was then occupied on his large work on the cathedral of Cologne; inquiries were made of M. Willemin, and it was learnt that the window in question formed part of a very large drawing of a church on parchment, and then in the possession of M. Imbart, an architect at Paris, who had obtained it from M. Fourcroy. M. Fourcroy, it seems, had found it in Belgium. M. Boisserée contrived to purchase the drawing, and it was at once recognized as representing a part of the façade of Cologne cathedral.[*] It was afterwards sold to the King of Prussia, and His Majesty presented it to the city of Cologne. United with the drawing discovered at Darmstadt, it represents the whole of the principal front. The size of the drawings together is about 6 ft. 6 in. wide, and 13 ft. long.

The longevity, it may almost be said the *immortality*, of an idea hardly needs illustration; if it did, the design of this cathedral might in part serve the purpose. Recorded centuries ago by the mind which conceived it, the intention is but now about to be fulfilled; and what its realization at this moment may further lead to, yet remains to be seen. Another and an analogous instance is now before us. Two hundred years ago Sir Christopher Wren proposed to rebuild London with the Exchange in the centre, and the main streets radiating from this building on all sides. Circumstances were opposed to it, and the intention has lain dormant. In our day, however, one of our countrymen, called in to advise on the rebuilding of Hamburgh, has re-urged this idea, and if I am rightly informed, so successfully that the senate is about to adopt it in the new city. The emanations of the mind, like the mind itself, may be said to endure for ever—they continue to operate through the world, and to influence the future long after their origin has been lost sight of.

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[*] It is supposed that the plan had been carried from Cologne about the middle of the 15th century, to serve as a model for the numerous churches which were then built in the Low Countries.

To return, however, to Cologne cathedral. Thanks to the power of steam, and the situation of the city on the Rhine, this structure has been viewed by most of us, and it would be impertinent to make remarks upon that with which you are as well or better acquainted with than myself. A short time ago, however, M. Daly, the editor of the "*Revue Générale de l'Architecture,*" of Paris, kindly forwarded to me some information on the late repairs and decoration of the building, and an account of the enthusiastic efforts which are being made, not merely in Germany, but in other countries, to ensure the completion of the building. It is the substance of this information which seems to be sufficiently interesting to be worthy your attention, that I propose briefly to bring before you.

I may remind you that the first stone of the present building was laid on the 14th of August, 1248, and that the choir was consecrated Sept. 27, 1322, or 74 years afterwards. It was more than a hundred years after this date before the south tower was taken up to its present altitude, hardly half its proposed height; the north tower is even now not more than 20 feet, perhaps, above the ground.

When the soldiers of the French republic had possession of the city at the end of the 18th century, the cathedral was used by them as a stable, and was considerably injured. Moreover, iron cramps, which had been extensively used in the construction, caused great ravages in the stone work, and there being no funds with which to repair the evil as it became apparent, the destruction of the building seemed more than probable. After the peace, endeavours were made to restore the damage, but it was not till 1821, when the King of Prussia interfered zealously, that the matter was taken up in earnest.

In 1829 the complete restoration of the choir was commenced, (including the rebuilding of the flying buttresses, galleries, and windows,) which most desirable work is now achieved, and as it would seem most satisfactorily. A very hard and durable stone has been employed in the restoration, and the architect has studiously avoided the use of iron in the masonry, so far as was practicable, either dovetailing the stones together where additional solidity was required, or when this was deemed insufficient, employing clamps of bronze. The outlay since 1829 alone, has been more than £40,000, partly furnished by the Prussian government. The immense scaffolding which still fills the choir of the cathedral, is about to be taken down so as to expose to view the decorations that have been applied.

Beneath the whitewash with which the interior of the choir was disfigured in the last century, they discovered the painted decorations that originally adorned it, and in which the colours were applied with a sobriety and wisdom rarely met with in the works of the middle ages. All the principal parts of the construction, such as the columns and ribs, have been re-covered with a yellowish plaster, to remove the cold tint of the stones, the joints of the masonry being nevertheless left visible. The smooth surfaces of the roof are painted in imitation of the *pierre de tuf*, of which indeed the roof is constructed. Some red bands or fillets separate the light colour of the plain parts from the deeper tone of the ribs, and serve to give the latter more relief. The leaves and ornaments of the key-stones, the capitals, indeed all the sculptured portions, are gilt with a backing of bright red.

In the heads of the pointed arches above the triforium, angels are painted on a ground of sculptured ornaments, gilt. The wall of the cloister, even, is covered with paintings of the 14th century. On the interior surface they represent processions, upon a gold ground; on the exterior figures of saints, on a blue ground, powdered with stars. The mouldings of the pointed arches which enclose the figures are also very richly painted.

Fourteen colossal statues, representing our Saviour, the Virgin Mary, and the apostles, are placed against the pillars of the choir, and are said to be models of monumental sculpture and polychromatic decoration. The draperies are painted to imitate rich damask stuffs, adorned with embroideries, coloured and gilt, representing animals and birds, executed with skill. It was much feared, in consequence of the thick coating of dirt with which time had covered these figures, that the renewal of the painting would have injured the effect of the sculpture; so far from this, however, the success is most complete.

This magnificent assemblage of architecture, sculpture, and painting, is made perfect by a series of stained glass windows, of the commencement of the 14th century, which, instead of injuring the effect of the mural paintings, by the coloured light which flows through them into the beautiful structure, harmonize the whole, and produce an effect which I can well conceive to be very striking.

The choir with its side aisles and chapels is, as already mentioned, the only part of the cathedral which is complete, the towers and nave remaining in an unfinished state—a splendid promise only, an outline of a magnificent intention, which yet remains to be filled up and made perfect. It seems possible, however, that it may not remain so much longer. Fired by the successful restoration of the ancient works, and anxious to realize the original idea in all its integrity and unity, the inhabitants of Cologne have determined on continuing the works vigorously. On the 16th of February a society was organized for that purpose, and the day was set apart for religious intercession and rejoicing. The enthusiasm displayed on this occasion is said to have been extraordinary; a procession of more than 5000 persons took part in the ceremonies of the day; Protestants and Roman Catholics, liberals and conservatives, joined on one common ground, and outvied each other in generous efforts to ensure the completion of this fine monument bequeathed by the middle ages to modern times.

This outburst of feeling on the part of the inhabitants of Cologne has been responded to, not merely throughout Germany, but in the neighbouring countries: branch societies have been formed for the purpose, literary men and artists have associated to publish magazines, the profit of which is to be devoted to the cathedral, a committee to receive subscriptions has been organized in France, and another in Rome; the King of Prussia has made himself responsible for £8000 *per annum*, and has further suggested that each of his provinces should defray the cost of one of the flying buttresses. The King of Bavaria, as in most similar instances, is not behindhand in the good work, but has formed committees in all the towns of his kingdom, and moreover has commissioned the manufactory of stained glass at Munich to produce three fine windows for the cathedral, at the cost of £3200. In Germany all classes of society, all professions, all faiths, have spontaneously united in favour of the projected work, not merely, as M. Daly suggests, under the influence of a lively interest in the welfare of the arts and for their sublime creations, or even from a sentiment of piety, but from a new-born feeling of the re-establishment of moral unity in Germany, and a desire to retrieve its ancient grandeur. Piety, art, and patriotism—love of God, love of the beautiful, love of country—unite in favour of the completion of a building in which modern Germany will give her hand to the Germany of the middle ages, across three centuries of discord. Architecture has been too often called on to embellish the triumphs of brute force; in this case it may record the willingness of a nation to be united. From the Bible we learn, continues M. Daly, that the first great monument with which architecture ornamented the world was the Tower of Babel, that is to say, of *confusion*, of *discord*. It is worthy of the architecture of our day to complete a noble edifice, high upraised, which may be at once a temple to God and a record of union.

To this I most fervently respond, and trust that the patriotic and elevated desires of the German people on this head may be fully carried out. The crane of the ancient builders has continued to surmount the grass-covered summit of the tower, mutely telling of their return, and prophesying ultimate completion.* I venture to express a hope that it may soon be seen again at work, playing its part in a much more elevated position than it is now.

George Godwin, Jun.

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* Being decayed, it was taken down in 1816, to prevent accidents, but was restored in 1819.

NOTES ON STEAM NAVIGATION.

Boilers.—If the steam space be contracted, there will inevitably be a large consumption of fuel as well as a low degree of efficiency in the engine; for the steam will be mixed with particles of water, which will carry off much heat, and this water by entering the cylinder will endanger the safety of the engine, at the same time that it diminishes its power by resisting the motion of the piston, blocking up the ports and choking the condenser. It is only when the quantity of water which comes over with the steam is very great that these effects are obvious; but every particle of water mingled with the steam is a positive detriment, and the only effectual preventative of the evil is to make the steam space abundantly large. Mr. Watt's proportion, which is well known, is we believe better than any other.

It is a usual and judicious practice to take the steam from the highest part of the boiler or steam chest, generally by an internal pipe turning upwards and in continuation of the steam pipe. This internal pipe is sometimes made of malleable iron, in which case it rapidly oxidizes, and in the course of a year or two will often disappear altogether. Copper is the best material, and a round pipe is preferable to a square or flat one. The latter description we have known to have had its sides squeezed together by the difference of the pressure of the steam within and without it.

The oxidation of boilers is an inexplicable subject. The outsides of boilers are chiefly worn—on the bottoms by leakage, or the action of the bilge water—in the ashpits from the wetting of the ashes—and on the top from the dripping of water from the deck. The insides are subject to oxidation only above the water line—not equally over the whole surface of the iron bounding the steam space—but more in one part than another, and the difference is traceable to no specific cause with which we are acquainted. It is generally observable, however, that oxidation proceeds most rapidly upon those parts upon which the steam impinges, and also upon the parts adjacent to brass or copper. The iron in the neighbourhood of the safety and stop valves is generally the most rapidly corroded; but this effect is not invariable, nor is it known to what the want of uniformity is due. The oxide is sometimes detached in a number of consecutive black scales, like the leaves of a book, which fall off only when disturbed; in other cases no oxide adheres to the surface of the iron, and the only evidence of the existence of oxidation is the diminution of thickness in the plate, which is readily observable where two plates overlap. A very thin coat of Roman cement might be applicable to the interiors of steam chests with advantage, either in conjunction with pieces of zinc, or zincked iron, or *per se*.

Hanging bridges.—Every boiler should have a hanging bridge at the extremity of the flue where it enters the chimney, projecting downwards 18 in. or 2 ft. from the top of the flue, according to the depth of the flue and other circumstances; and the best boilers are so provided. This hanging bridge may be made either of brick or of plate iron; its effect is to retain the hot air in contact with the iron, and to permit that portion only which occupies the lower part of the flue, and is consequently the least hot, to escape to the chimney. A hanging bridge at every turn of the flue has in some instances been used with much advantage.

Furnace bars.—Where the length exceeds 7 ft. it has been found that more steam is generated and less coal burned, by shortening them. They must never be bound at both ends, nor the bearers be so constructed as to permit ashes to accumulate in the space left to allow of the expansion of the bars, else the expansion will either break the bearing bars or the brackets which support them, or the middle portions of the bars will bend up into the fire, and be quickly burned away. If there be two sets of bars in each furnace the middle bearer should be double, to allow the ashes to fall into the ash-pit through the space between the ends of the respective sets of bars. The front bearer should also be removed a little from the dead plate, and the back bearer a little from the bridge, for the same reason.

Paddle Wheels.—The loss of beneficial effect from backwater is not great, but there is another source of loss hitherto unnoticed, though of no trivial moment. The impulsive velocity of the several floats immerged in the water is proportional to their horizontal distances, that is, supposing that there are four floats immerged, the distance through which the first float *tends* to impel the vessel during its motion from the position of the first to that of the second float is equal to the horizontal distance between those floats, whilst distance through which it tends to impel the vessel during its motion from the position of the second to that of the third float being, in like manner, equal to the horizontal distance between those floats, is a very different quantity from the first. Thus there are two forces acting with different velocities at the same time, and these forces must be to a certain extent antagonistic. If we suppose the vessel to be moving with the velocity due to the motion of the float from the first to the second position, then the excess of velocity due to the motion of the float from the second to the third position is thrown away in giving a useless velocity to the water; whilst, if we suppose the vessel moving at the latter velocity, or at a velocity approaching thereto, the floats entering the water become an actual impediment to the vessel's progress, and will carry a mass of broken water before them, in the same way as the bow of the ship, and in practice we have seen this occur. To prevent the loss of power from this source, the relative velocities of the floats should be such that the horizontal distances travelled over in equal times should be equal.

Slide Valves.—It is always best for the faces on the cylinder to be formed of face plates of cast iron, from 1½ to 2 in. thick. When the engine is of sufficient magnitude to render an expansion joint in the casing expedient, the best mode of fixing the face plates is to screw them to the cylinder with countersunk bolts, both of the surfaces having been previously planed, and a little red lead interposed. In other cases it is as good a plan to fix the face plates to the valve casing, the surfaces being planed as before. The bolts which attach the casing to the cylinder will also serve to keep the face plates in contact with the casing; but they must be screwed at both ends, and have a conical enlargement in the middle to fit into the holes of the face plates, which holes must of course be made conical likewise.

No large cylinder should be faced lying on its back, for its own weight alters its form, and makes the valve face untrue; emery should not be used in grinding a valve to its surface. The most approved practice is to make the two surfaces first, as true as possible by planing; next, to try the valve on with a little reddening, and help the surfaces cautiously with a file where required; and finally, to polish with powdered Turkey stone and oil.

The effect due to a given quantity of lap or cover upon the steam and exhaustion sides of slide valves, as well as of that due to various degrees of travel in the valve, are questions looked upon as very mysterious, and they are certainly important.

If s = half the length of the stroke of the piston in inches;
s' = half the length of the stroke of the valve in inches;
t = that part of the stroke completed before the steam is cut off in inches;
t' = that part of the stroke completed before the exhausting port is shut;
t'' = that part completed before the exhausting port at the other end is opened;
c = cover on steam side;
c' = cover on eduction side;

$$\text{Then } t = s\left\{\ 1 + \cos.\left(2 \sin.^{-1}\frac{c}{s'}\right)\right\} \qquad (1)$$

$$t' = s\left\{\ 1 + \cos.\left(2 \sin.^{-1}\frac{c+c'}{2s'}\right)\right\} \qquad (2)$$

$$t'' = s\left\{\ 1 + \cos.\left(2 \sin.^{-1}\frac{c-c'}{s'}\right)\right\} \qquad (3)$$

By these formulas the action proper to valves with any degree of cover or throw may easily be computed.

Cocks.—Every cock about an engine—gauge cocks and all—should have a bottom and a stuffing box, else they will be very troublesome as soon as they begin to leak; blow-off cocks in particular are a perpetual annoyance without this provision. The valves invented by Mr. Kingston of Woolwich as substitutes for cocks are very ingenious, and we understand operate most satisfactorily. All vessels should have these valves, or some analogous contrivance, at the place where the blow-off and injection pipes penetrate the vessel's sides, both for the purpose of preventing the escape of water into the ship in the event of the pipes being broken, and to permit the blow-off and injection cocks to be re-ground, without involving the necessity of taking the vessel into dock.

NOTES ON THE CONSTRUCTION OF BRIDGES OF CAST IRON, WITH SOME EXPERIMENTS ON THE STRENGTH OF CAST IRON GIRDERS OF LARGE DIMENSIONS.

The basis of calculation of the strength of cast iron beams is derived from the fact of a bar one inch square and 12 inches long breaking with one ton; consequently the square of the depth, multiplied by the thickness and divided by the length in feet, gives the breaking weight in tons. In a table given in the *Journal*, vol. iv, for 1841, p. 79, the specific gravity of cast iron is stated as 7·827, which, taking water as unity, gives 460¾ lb. as the weight of one cubic foot of cast iron. It is also observed that if the gravity be different, the strength must be reduced in proportion; another authority gives 455⅓ lb. as the weight of a cubic foot of cast iron. Both of these weights are sufficiently near for practical purposes. The weight of metal in a structure may be found by multiplying the length in feet by the number of square inches in the section, and by 3·2 (the weight in lb. of a bar one foot long and an inch square), which will give the weight in lb.; or find the number of cubic inches, and divide the same by 3·75, which will also give the weight in lb.

In the Second Part of the Transactions of the Royal Society, 1840, is a paper "On the Strength of Cast Iron Pillars," by Eaton Hodgkinson, Esq., from which I extract the following. The ratio of strength is constant in pillars whose length is 30 times their diameter, up to 120 times, but not in shorter lengths. In the experiments, when the pillars broke, it was generally in the middle, as if the weight had been applied transversely. The theory of the comparative strength of pillars is that they vary inversely as the square of the length: *e. g.* a pillar half the length of another of like area, in section would have four times the strength. In the experiment the pillars broke with ⅓ to ¼ the crushing weight. The crushing weight of cast iron is 49 tons, and its tensile power about an eighth of that amount. If the crushing weight of cast iron be taken at 1.000, wrought iron would be 1·745.

The rule as given by Barlow for the stiffness of cast iron beams is that it is as the cube of the depth if the weight be in the middle, and if distributed ⅝ of that weight would be borne with an equal degree of deflection.

In the above extracts sufficient is developed of the theory of the strength of iron for the present purpose of illustrating these notes.

In Weale's work on bridges, we learn that iron was introduced as a main constituent of a bridge in 1775, by Thomas Fainolls Pritchard, of Shrewsbury; also that the principles that govern a bridge of carpentry are the same as for a bridge of iron, and in cast iron bearing bridges the construction must be considered as partaking more of the beam than the arch, although there are some important works in which the properties of the arch appear to have been mainly depended upon by the engineer. In the celebrated Sunderland Bridge, 236 ft. span, the versed sine being nearly that of a semicircle, the principle of the arch is fully carried out, small portions of the arc being in frame work, like the *pend* stones or voussoirs of a stone bridge. In Southwark Bridge, London, of three arches, the centre 240 ft. span, and the side arches 210 ft. each, with a versed sine of 24 ft., the ribs of the arches are in long lengths, and 6½ ft. in depth. This bridge contains 3115 tons of iron: the centre arch alone contains 1665 tons. Up to 1830 there were only two cast iron bridges erected in France—the Pont des Arts, of a similar construction to Southwark Bridge, and the Pont de Austerlitz. The reason of this material not being more extensively used in that country up to 1830, was stated to be the great expense of iron, and the uncertainty of casting large pieces; although the same writer states, in favour of the use of this material, that it is adapted to bridges of large spans, and that it is as durable as stone, less expensive, more easily constructed, and, as compared with wooden bridges with abutments of stone, is one half less expense. A new construction of iron bridge has been invented by M. Polonceau, and erected at Nantes, in the Bridge of Eidre, and the Carrousel Bridge of Paris, drawings of which are given in vol. ii. of the *Journal*, p. 79: they are called Polonceau bridges after their inventor; see vol. iv. of the *Journal*, p. 92, whence the above account has been condensed. The Carrousel Bridge was completed in 1836; it has three arches, centre 187 ft. span, rise 16½ ft.; two side arches 156 ft. span, and rise 15½ ft.; width of piers 13 ft. The principle of construction is a wooden arc on the laminated principle incased with cast iron, the transverse section being elliptic and cast in 22 lengths and from its shape has been called the "tubular rib." From the preceding notes sufficient has been shown that cast iron can be used in bridges to the extent of 300 ft. span. When the circular arc is used similar to Southwark Bridge, engineers are agreed that $\frac{1}{10}$ of the chord line is a sufficient rise, and that $\frac{1}{10}$ of the span is sufficient width for the piers, the strength of the abutments being regulated merely as retaining walls. But they are not agreed whether greater depth should be given to a rib at the haunches and diminish towards the crown, or that the greatest depth should be at the crown and diminish towards the abutment.

Provided that the principle of a beam girder, brestsummer, or joist be considered as the true theory of construction, a beam parabolic on the upper edge and horizontal or level on the lower edge, and reduced at each end to one-third of its depth in the centre, will be equally strong as if its form was parallel throughout. On the London and Birmingham Railway a bridge is constructed under the Hampstead road, where the lower edge of the beam is cambered with a versed sine of 3 ft.; the upper edge is also circular, being drawn from two centres, the extreme depth being 2 ft. in the centre, and 9 in. at each end: the span is 25 ft.; sectional area in middle 67¼ superficial inches. There is another bridge on the same railway crossing Park-street, of two openings of the same span; the beams have a sectional area of 56¾ in., and are horizontal at top, and cut out in the centre to the form of an arch, the spandrils being filled in solid. From the above two bridges a fair comparison may be instituted, and the inference drawn that no advantage is gained in material in adopting the arch, over the girder; and I apprehend also that the only advantage gained by the two centred or bent girders, whose elevation is a "phase" like the new moon, is in the extra depth acting in a perpendicular or ordinate line, and not on a radius line with either of the arcs. It may be also inferred that if the bridge be of large span and the arched form used, it will be necessary for calculating the breaking weight of the bridge to take the whole depth from the chord line, including the depth of the roadway bearer, and deducting therefrom the openings between the spandril fillings. Indeed no advantage is gained in confining the principal weight of iron used in the structure to the arch formed at bottom, over the equal distribution of the weight over the roadway bearer, and filling in of the spandrils. By this means the insistent weight, or the weight of the materials composing the structure, is more equally diffused over the whole erection. In farther confirmation of the above remark, that no advantage is gained in adopting the arch over the girder, I may observe that in the arched form all above the piers are cast iron, which rest upon bed frames or dead plates laid on the piers, and that the ribs are strengthened longitudinally by fillets, mouldings, flanches, &c., and that when the structure is of more bays or spaces than one, the different ribs in each arch are united by junction pieces on the piers in the direction of each rib. The ribs are also strengthened sideways with vertical diagonal frames or cross stays and distance pillars, and with horizontal diagonal braces and the roadway plates, so that the whole forms a complete square piece of framework, and may be compared to the American trellis bridge, with a circular piece cut out of it to form a headway between each pier.

But to return to the principle of construction of iron bridges, as adopted by various engineers on the railways in England. I will give a description of the different kinds of bridges which have been constructed of this material. The principle of the bow and string suspension, as employed by Mr. Leather in the bridges of Hunslet and Monk Bridge at Leeds, (the latter being 112 ft. span, the former 152 ft. span,) has been adopted on the Thames Junction Railway, and on the London and Birmingham line the same principle is applied to a bridge over the Regent's Canal at Camden Town, the roadway being on the chord line, and the ties of the bow strong bars of wrought iron: the span is 50 ft. On the same line, the road from Banbury to Lutterworth is carried over the railway on a bridge, with a span of 64 ft., in this case the road is above the bow, and the ties are distended below the chord line: the distance between the under side of the bow and tie bar is 4 ft., which is filled in with studding pieces or saddles, about the same scantling as the spandril filling of a bridge of similar span ought to be on the common construction. The same plan has been used on the Manchester and Leeds road as the bridge over the Regent's Canal; in this bridge 268 tons of wrought iron, and 155 tons of cast iron were used: a similar bridge is on the North Midland line, at Derby. This kind of bridge is used where headway under the bridge is an object. On the Birmingham and Gloucester line, at Cheltenham, a bridge is built on the above principle, where both the rib and the tie at the level of the roadway are cast iron, the lower one being suspended at a distance of 4 ft. 3 in. from the upper, with strong iron rods about the same distance apart; the tie or bottom rib has also a rise or versed sine of 18 in. On this line of railway 654 tons of cast iron, and 150 tons of wrought iron were used in bridges. On the Great Western Railway parallel girders were mostly used. In a bridge over the Paddington Canal 37 ft. span, the extreme depth of girder is 22 in., and breadth of flanch at top and bottom 9½ in., of a uniform thickness of 2¼ in.; the weight of iron in the bridge is 41½ tons. A similar bridge to the last was erected over the Grand Junction Canal, in which above 73 tons of iron were used; the dimensions are as in the last example, except the span and depth of girder; the latter is 26 in. deep. The bridge over the Uxbridge road, containing 165 tons of iron, is on the principle of a framed floor of joists: the railway crosses the high road very obliquely, say 15°, at the junction of a cross road; one girder is used similar to a trimming joist, with seven others weighing about 30 tons, tenoned through it and bearing upon it. This girder weighed 9½ tons, and was 26 in. in extreme depth, with flanch at top and bottom 11 in. broad, of a uniform thickness of 4½ in., and 32¼ ft. long between bearings. This girder broke soon after the bridge was completed, but was replaced again without increase of weight. On the Midland Counties line the parallel girders were assisted with side rods of wrought iron, their ends being passed through cast iron lugs, on the upper edge of the girder, and the middle bent over a stud cast on the lower edge in the centre, the superstructure or roadway being generally planking, but where the girders were elliptic, the planking was placed on the lower flanch, and the back of the girder stood above the roadway. On the Great Western line the space between the girders was filled in with 9 in. arched brickwork, the girders being placed about 4½ ft. apart. On the Pollack and Govan Railway, the Glasgow and Edinburgh, Grand Junction, and Leeds and Selby, the bridges were of the ordinary form.

The weight to be carried over a bridge or railway should be calculated for two trains passing over at the same time, and for a turnpike road the passage of troops is considered the most severe test, but in practice one of the ribs should be calculated to bear the estimated weight which it is presumed will pass over the bridge. In the Park-street bridge previously described, of 95 ft. span, an area of 56 superficial inches is given to the rib; and in No. 7 of the first table of experiments, for a span of 28 ft., with 10 tons the deflection was ⅜ of an inch, the sectional area being 38 in., evidently showing the Park-street bridge abundantly strong. By a reference to the unpublished experiments on cast iron rails, you will see that the (perceptible) deflection of cast iron commences at about one-fourth of its breaking weight, so that the girder No. 7, with an area in section of 38 in. would be capable of sustaining a weight of 40 tons. The girder of the bridge that broke on the Great Western Railway at the Uxbridge road had an area of nearly 176 in., with a span of only 32 ft.

By reference to the paper in the Transactions of the Royal Society it will be seen that wrought iron will bear nearly as much again as cast iron before crushing, and by reference to Wood's experiments on rails, it will be observed that it remained elastic up to five-sixths of the weight that destroyed its elasticity, and the deflection commenced with one sixth part of that weight; therefore, notwithstanding the greater power of its resistance to a crushing force, the greater elasticity renders it inapplicable to the purposes of bridge building on the plan of an arch.

I have been induced to extract the table from Wood's work on railways, to see whether wrought iron was applicable for bridges constructed on the common plan, having lately seen curved ribs of that material formed of railway bars acting as the support of the "lagging" of centreing, and as Mr. Pritchard (who introduced cast iron), in one of his earliest propositions on the subject, suggested cast iron ribs as a permanent centre to a back arch of masonry (Weale's Bridges, page 100).

From what has been said, I do not think wrought iron can be applied as I thought it could to large bridges. In the preceding examples of construction are the following different plans. The principle of the arch fully developed, as in Sunderland Bridge; arched ribs on the common plan, as Vauxhall and Southwark Bridges; the French tubular rib; the bow and string, as Monk Bridge, Leeds; and four descriptions of girders, viz. parallel, parabolic, parabolic curved, or one whole elevation as a phase, and the parallel assisted with tension rods; also an adaptation of the bow and string of three varieties, viz. the bridge over Regent's Canal, on the road from Banbury to Lutterworth, on the Birmingham railway, and the Cheltenham bridge on the Gloucester and Birmingham railway; being a total number of thirteen different constructions, many being used to suit localities and confined situations; but for situations where no restrictions exist, the girder is the best form up to 30 ft. span, the arched bow and string to 60 ft., the common arch to 150 feet, the framed voussoir, as Sunderland bridge, to 250 ft. and all spans larger.

As to what should be the sectional area when the common method is practised, the following particulars, collected from executed examples, may be found useful: say 25 ft. span, 30 superficial inches; 50 ft., 40; 100 ft., 110; 130 ft., 165; and the proportion of the breadth of the rib to its depth, one-fifteenth, say 2½ inches breadth for 36 inches depth.

1st Table of Proof in Tons and Deflection in Inches of Cast Iron Girders elliptic on upper edge.

No. of Experiment.	Distance between supports in feet.	Extreme depth in centre. inches.	Do. at ends.	Size of Fillet at top.		* Size of Flanch at bottom.		Breadth or thickness in middle.	Proof in tons.	Deflection in inches.
				Breadth.	Depth.	Breadth.	Depth.			
No. 1	18 0	14¾	11¼	1¾	1¾	4	1¼	1¼	6	⅜
2	22 6	18	15	1¾	1¾	4½	1¼	1¼	8	¼
3	17 9	13	11½	1¾	1¾	4	1¼	1¼	6	⅜
4	22 0	15	12	1⅝	1¾	5	1¼	1¼	6	¼
5	19 6	15	12	1¾	1¾	5	1¼	1¼	6	⅜
6	13 0	10	8	1¾	1¾	7	1¼	1¼	4½	¼
7	28 2	20½	17½	2	2	6	1⅜	1⅜	10	⅜
8	13 4	12	10	1¾	1¾	4	1¼	1¼	6	¼
9	32 4	24	19½	2	2	8	1⅜	1⅜	12½	¾
10	20 6	15	12	1¾	1¾	5	1¼	1¼	6	⅜
11	12 8	10	8	1¾	1¾	4	1¼	1¼	4½	5/16
12	19 6	15	12	1¾	1¾	4½	1¼	1¼	6	⅜
13	18 3	16	13	2¼	2¼	6	1¾	1¾	13½	½
14	36 0	30	24	3	2	9	2⅜	2⅜	20	1/16
2nd Table of Girders parallel throughout their entire length.										
1	10 6	9¼		5	1¼	5	1¼	1¼	6	⅛
2	8 2	9¼		5	1¼	5	1¼	1¼	7	3/16
3	10 0	10		5	1¼	5	1¼	1¼	6½	3/16
4	9 0	8½		1½	1¼	7	1¼	1¼	7	3/16
5	20 6	20		6	1¾	6	1¾	1¾	15	3/16
3rd Table constructed from Wood on Railroads, Experiments on Strength of Wrought Iron Rails.										
1 28lb.	3 0	3 7/16	2¼	2¼ ×	1	none	none	⅝	6½ to 7¾*	½
2 36	3 0	3 11/16	2⅜	2¼ +	15/16	¾	¾	⅝	3½ „ 5	Bent.
3 32	3 0	3⅛	2⅛	2¼ ×	¾	1	1 3/16	⅝	2½ „ 3½	do.
4 32	3 0	3 9/16	2⅞	2 3/16 ×	1	⅞	1 7/16	⅝	5 „ 6	do.
5 39	3 0	4 1/16	3⅜	2¼ ×	1	1	1 5/16	⅝	5 „ 6	do.
6 43	3 0	3⅞	3⅞	2¼ ×	¾	1 3/16	1 3/16	⅝	5 „ 6	do.

* With the first weight the elasticity remained, with the second weight it was destroyed.

Explanation of Table.

he girders were laid together in pairs, with a block of iron between at
and squeezed together, and the diminution of the distance between
rders was divided as the deflection of each. Before the pressure
ed, parallel chalk lines were struck at a small distance apart, to
he position of the neutral axis, which was found to be nearly in
of the depth. The bearing was 9 in. from each end, and the
pplied in the middle: the girders were kept from going back to
al position by a strong loop of wrought iron embracing them both.
s were elliptical on the upper edge or back, and horizontal on the
; they were also strengthened on the upper edge, and had a broad
ottom, and sometimes a flanch at both top and bottom. The
the girders, except No. 14 in the first table, were used at the
d Cambridge Club. No. 14 was also used in the construction of
London School, Cheapside. After the above experiments, the
n his next work, the Judge's Chambers, abandoned the fillet at top,
shed the thickness; as for example, a girder of the same length
as No. 1 in the first table had a uniform thickness of $1\frac{1}{3}$ in.,
entre 15 in., at end 10 in., breadth of bottom flanch 4 in.: the
the last-named work were not proved.

Ir. Wood calls the three divisions of the section "top, rib, and keel,"
ng the portion between the top and keel, for which two last terms
stituted the words fillet and flanch, and for the whole three terms
extreme depth. No. 6 is the only rail that was parallel, which
3 lb. per yard, and No. 4, which weighed only 32 lb. per yard, was
fish bellied: it retained its elasticity as long as No. 6, with an
ht.

od gives one table of experiments of cast iron rails, the average
55 lb., 3 ft. 9 in. between supports, being straight on the upper
parabolic on the under edge; extreme depth in centre 6 in., at end
dth at top $2\frac{1}{4}$ in., tapering away to $1\frac{1}{2}$ in the middle, and swelling out
into a square, each side being $\frac{7}{8}$ of an inch, and the diagonal being
roke with $5\frac{3}{4}$ tons; and he observes that cast iron is very rigid,
ion trifling before fracture, and that by mixture of metal, so as to
s specific gravity, the same rails took $1\frac{1}{4}$ tons more weight to
n.

owing are from experiments which have not been published. A
t iron, straight on top, elliptic on bottom, edge 7 in. deep in
in. at each end; flanch at top $2\frac{1}{2}$ in. × $1\frac{1}{4}$ in., at bottom $1\frac{1}{4}$ in.
d $\frac{1}{2}$ in. thick in the middle; with 5 tons, in the middle deflection
nt; distance between supports 3 ft. 8 in.
s, the deflection was $\frac{1}{108}$ of an inch.
" $\frac{1}{72}$ "
" $\frac{1}{54}$ "
" $\frac{1}{36}$ "
" $\frac{1}{24}$ "
" $\frac{1}{20}$ "
" $\frac{1}{8}$ " Broke instantly through its centre.

cast iron rail, 2 ft. 8 in. between supports; 5 in. in middle, $3\frac{1}{2}$ in.
d, and $\frac{1}{2}$ thick; flanch at top $1\frac{1}{2}$ in. × 1 in., at bottom $1\frac{3}{4}$ in. × $\frac{7}{8}$ in.;
$8\frac{1}{2}$ tons; fracture in the middle, and nearly perpendicular.

's, Newcastle-upon-Tyne. O. T.

LIGHTNING CONDUCTORS.

on lightning conductors, in connexion with the accident at Brix-
, was lately read at a meeting of the London Electrical Society.
Mr. Walker, the secretary of the society, had made a survey of
e done to the tower of Brixton Church, and found in it so practical
tion of Dr. Faraday's opinion on the "lateral discharge," as to
to investigate the subject more closely. It seems that no ar-
of metals could have been better adapted than that met with in
e to invite a flash of lightning to do mischief. There was a regular
epping-stones, as it were—first, an insulated metallic cross, then
t of stone work; in passing this interval the roof of the lantern
red. Then come twenty or thirty feet of conductor, in the form
k wire, and a water pipe; and then a break of twelve feet. Here,
an explosion, and an immense mass of masonry was shattered away from the base of a column intervening between the termination of the water-pipe and the commencement of the next series of conductors. Within the belfry a "lateral discharge" took place; the fluid passes from one conductor to a vicinal one for no other reason than to obtain a wider path. The author showed that electricity not only chooses a short but also a wider path; and that the "lateral spark" arises from the latter property. He then explained that it is not enough to have a continuous or an insulated lightning rod; but it is most important to have it far away from other metallic bodies; for however capacious the rod may be, and however adapted to convey, not only what passed down it, but ten thousand times more, yet, if another conductor is near, a flash will pass between the two, and ignition of neighbouring combustibles will be the result. Fortunately, in the case in question, only a small part of the whole fluid passed within the tower, consequently the lateral explosion was not severe. As it is not always possible to place lightning rods entirely out of the neighbourhood of other conductors, Mr. Walker showed that the possibility of the fluid's passing between them should then be converted into a certainty by making metallic communication between them, and thus tracing out a path along which the fluid might pass without the development of light and heat. He spoke of the peculiar property of the points of leaves, twigs, &c., in drawing off quietly charges of electricity, and stated his conviction that tall trees would always be found valuable, if not in entirely averting, at least in greatly mitigating the force of a lightning shock. The theoretical opinions given in this communication were based upon the experiments of the Royal Institution, the object of the author being to show how closely they were illustrated on the grand scale of nature, and to direct the attention of the public generally to a closer study of the properties of lightning-rods, a subject on which, perhaps, more than on any other practical point, more ignorance prevails than can be well conceived.

EXPERIMENTS AT WOOLWICH ON COAL-BOXES OF STEAM VESSELS.

On 11th May a large detachment of the Royal Artillery attended in the Marshes, to make experiments with powerful guns against the erection representing the side of a steam vessel, and the coal box. The experiments commenced at a range of 1250 yards, with 68-pounder and 56-pounder guns; Colonel Dundas' 110 cwt. gun requiring 18 lb. of powder to each charge, and Mr. Monks' 97 cwt. gun requiring 16 lb. of powder each charge, made excellent shots, but failed in passing through the coal-box, although the iron composing the interior portion of the case was rent for several inches where the balls had struck, and where they were retained, having evidently expended the greater portion of their force in passing through the coals. This result was rendered certain by the effect of one of the balls, which had passed through the portion of the erection extending beyond the coal-box, driving before it a solid piece of the wood, 12 in. square, and about 6 or 7 ft. in length, and ultimately passing through a similar thickness of wood in the rear, sinking deep into the earth composing the butt. There were three other guns, 56-pounders, respectively of 85 cwt., 84 cwt., and 67 cwt., in weight each, fired during the first six rounds, but they were then discontinued, and the practice carried on with Colonel Dundas' and Mr. Monks' guns, but they failed in destroying the coal-box to any greater extent than has been stated.

The experiments were resumed on the following day with Mr. Monks' 56-pounder gun, weighing 97 cwt. The officers in command were so satisfied with its practice, that it was ordered to discontinue firing after the 24th round. Several of the shot entered the coal-box, and caused great destruction; and although they did not pass through, they tore the joinings from the bottom to within about two feet of the top. Two more rounds were fired from the 68-pounder, one of which rent the joinings at the east end of the coal-box from the bottom to within about three inches of the top, and a great quantity of the coals fell out. The experiments with these guns, which were made at the long range of 1250 yards, having been concluded, General Millar's 10-inch gun commenced practice, having been previously placed at a range of 960 yards. The firing from this gun with shells was the best that could have been witnessed. The first shell entered the centre of the bull's eye, but did not explode, probably from the action of the loose coals through which it passed extinguishing the igniting composition before it could communicate with the contents of the shell. The second shell entered within about two feet of the bull's eye, and did not explode, probably from the same cause as in the former case. The third shell entered about nearly the same distance from the bull's eye as the second, only nearer the ground, and in six seconds exploded, throwing up into the air a flame of ignited small coals to a height of upwards of 30 ft., forming a grand and imposing spectacle, and scattering fragments of the shell, wood, and coals, to a distance of 200 yards in all directions. A fourth shell was fired, but it entered and exploded in the butt.

The experiments were again resumed on the following Friday, when it was resolved to fire the red-hot shot 32-pounders, at a range of 800 yards. The first of these entered at the bottom of the coal-box, nearly in the same line with the bull's eye, and set fire to the wood work, which continued to burn slowly along with the ignited coals. The second red-hot shot entered about three feet from the bull's eye, and so lodged amongst the coals that it was full a quarter of an hour before the smoke of the ignited coals could make its way through the hole where the shot entered, and at the top of the box, but it afterwards rapidly gained an ascendancy, and would have consumed the whole had not the fire been put out by a party of men with the fire engine. The experiments were concluded by firing an 8-inch shell from a battery, at a distance of 950 yards, and it struck in a horizontal line with the bull's eye, tearing the eastern side of the coal-box, and exploding when it reached the back part of the box, scattering the coals, fragments of shell, and wood to a considerable distance.

It is probable the result of these experiments, which have been so far satisfactory, will give rise to others of a similar nature, as they appear to be of great importance. Were the coal boxes made of iron half an inch thick, instead of a quarter of an inch, as the one experimented with, it would afford, especially at the back, a more secure hold to the rivets of the joinings, the only parts which may be considered as having given way during the severe tests. The action of the loose coals appears to have a great effect in preventing balls passing through them when about six or seven feet in thickness, and placed in an iron box, and the discovery may prove of great importance in future fortifications, and in the defence of important stations.

IMMENSE BLOCK OF STONE, SHIPPED FOR THE NELSON MEMORIAL.

On Thursday, 9th June, we had the pleasure of witnessing the arduous undertaking of putting on ship-board this huge block of stone, weighing 30 tons, intended to form the lower part of the figure of Nelson. This beautiful piece of liver rock, when first detached from its original site in Granton quarry, was 45 tons, its under bed resting 16 ft. 3 in. below the datum line of low water at Granton Pier. It had, therefore, to be raised a perpendicular height of 40 ft. over the inclined plane of the railway leading out of the quarry to the summit level.

It was first conveyed over the floor of the quarry nearly on the level 73 ft., then up an incline 96 ft. long, having a rise of 11 ft. 9 in., a second incline 430 ft. long, having a rise of 26 ft., a third incline 112 ft. long, having a rise of 2 ft. 3 in.

This was accomplished in three days by means of logs of timber laid down, covered with a strong flat iron bar, and malleable iron rollers 3½ in. in diameter, and hauled by strong purchase crabs; nearly another day was occupied in placing it on a wagon built for the purpose, and conveying it along the railway to the place of shipping, opposite the old castle of Granton, where a dock was excavated to admit the vessel coming alongside the rock, where the shears and other powerful apparatus were fixed.

Mr. Cole, who was entrusted with the management of shipping this gigantic block, and the Government stores for the purpose, has been eminently successful in his hazardous task. It appears, that to test the apparatus and ascertain if every part was properly proportioned and efficient, on Wednesday one of the three blocks required to complete the figure, weighing 13 tons, was shipped, and every part of the bearing acting perfectly satisfactorily, it was determined to ship the large one on the following day, should the tide flow sufficiently high. At half-past one o'clock we were on the spot, when the stone had been already hoisted, and in suspension between the ponderous shears, all hands anxiously waiting for the vessel. The Albion of Goole, Captain Wright, was placed alongside, there being then scarcely sufficient water. Precisely at two o'clock the vessel being hauled into her berth, the process of lowering the shears to the required angle being accomplished with great accuracy, the purchase tackles began to move, and so gradually and steadily was all this managed, that not the least creak or surge was perceptible in any part.

In 20 minutes from the commencement of lowering away, the vessel having received the block, which put her down exactly a foot, was hauled into deep water. Although a great number of people were congregated, not the slightest noise or confusion occurred: every one seemed highly gratified, from their giving three hearty cheers, on the vessel being hauled out.

His Grace the Duke of Buccleuch has made a present of these fine blocks to the committee of management for the memorial, and we feel happy in announcing their being safely shipped without the slightest accident.

We were happy to hear Mr. Cole express his sense of the kind attention and assistance received from Mr. Hawkins, resident engineer, and Messrs. Orrell and Wightman, contractors, Granton Pier.—*Edinburgh Evening Post.*

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, LONDON UNIVERSITY COLLEGE.

SECOND COURSE.—LECTURE VI. ON THE GAUGE OF RAILWA

After some preliminary observations, illustrating parts of the la
and particularly in reference to what was stated respecting the
railway, Mr. Vignoles proceeded to enter on the subject of the b
gauge of railway, which he explained to denote the distance bet
iron bars which form the track or way. The definition of the gau
old tramways, introduced the observation that, from their form be
were an artificial rut, they were styled by the French *ornières*, of
literal translation was "wheel-rut." The present ordinary railw
was 4 ft. 8½ in., and some speculations were made as to the choice
particular breadth; and quotations were made from Mr. Wood's
Railways to show that it had been owing to an accidental circumst
that the first conclusive experiments on the principle of the pres
motive engines had been made on the Killingworth Colliery railw
was laid to that gauge. In some of the first of the Acts of Parli
modern railways, it had been made imperative by a special clause
this particular gauge, and many companies submitted quietly to t
ment, thereby preventing all chance of improvement in what was
to be perfect *ab initio;* but about six years ago much discussion ha
place as to the proper gauge, this decree was altered, and there is
limitation in the width of the gauge, which is left entirely to the
of the engineer. Now, the consequence is, that although it woul
sirable that there should be a standard gauge fixed, yet, so divided
public been as to what is the right one, that we have at present no
seven different gauges used throughout the United Kingdom; so
Scotch lines, for instance, have a gauge of 4 ft. 6 in., and others of
The Eastern Counties Company have adopted 5 ft. The gauge of
ways in Russia is 6 ft. On the recommendation of the Irish Rail
missioners, the Belfast and Armagh Railway Company have m
gauge 6 ft. 2 in. On the Great Western Railway the gauge is 7
as much as 18 years ago, Mr. Tredgold, a celebrated and scientific
made the following observations:—"The width between the rails
pendant on the height of the centre of gravity of the loaded carr
this again varying with the nature of the load and the velocity,
obvious we cannot do better than make the breadth between the
that by disposal of the load, the centre of gravity may be kept w
proper limit in either species of vehicle, whether swift or slow, and
be desirable that the same breadth and the same stress on a whe
be adopted on all railways. We would propose 4 ft. 6 in. between
for heavy goods, and 6 ft. for lighter carriages to go at greater
Now, it is remarkable that, during all the discussions that took p
regard to the gauge, this observation was never referred to.
Brunel broke through that fixed number for the gauge, and adopted
he gave very strong and sound reasons for so doing; whether he
in assuming so high a number as seven is questioned by many, but
ciple upon which he went was this—"I have (said he) laid out th
nearly level as possible; the curves that I have adopted are nearly e
to straight lines; I keep the centre of gravity low, by placing the
the carriage within the wheels, and anticipating greater stability an
ness, I shall be able to go at a much higher speed, and with mu
assurance of safety." The Irish Commissioners argue thus—"
nature of the locomotive engine, its power is so great in proportio
friction it has to overcome, that it is capable of drawing a load wh
with a greatly increased breadth as compared with common road
extends to a very considerable length, and, in order to reduce this
much as possible, it is necessary with the present breadth of way
the wheels run within the frame which supports the carriages; the
the passengers are, therefore, placed above the periphery of th
which, for the sake of lowering the height of the centre of gravity
as small as possible."

One great theoretical objection, therefore, to the narrow gauge, i
creased friction consequent upon the reduction of the diameter of t
since besides what is due to the load, the friction of a wheel, at
may be said to depend upon the proportion of the diameter of the
the diameter of the axle; but, in attempting to carry out this pri
practice, the axle has sometimes been turned down so small as to
much greater and more positive inconveniences, and it is very que
if it be prudent or desirable to make the proportion between the w
axle greater than 15 to 1, and which proportion can be obtained wi
wheels. Now, with a 4-feet wheel and a 3-inch axle, the proporti
16 to 1, it may be well doubted if, on this account alone, the larg
are worth their greatly increased cost. The commissioners, howev
that the same carriage room may be preserved, by extending the br
bearing of the rails, so as to allow the wheels to run outside the fr
stead of running within it, in which case we can bring the body of

ꞁwn to the axletree. The gauge may be thus increased from 4 ft. 8½ in. 2 in.—thus arguing for an increased breadth, that the centre of may be lowered, and the diameter of the wheels thereby reducing tion, and increasing the power, to overcome the "surface resistance." in other words, getting more leverage; but such an advantage, how- es not apply so much to railways as to common roads, for, on the , there is little or no obstacle to be found in the shape of surface re- , except what are as a few grains of dust compared with the obstacles und on the common road, or the deep ruts in a wood, which require rge wheels for the timber wain. "At the same time (continued the sioners), the load itself may be reduced in height, the bottom of the e, or truck frame, being, in this case, limited by the axletree of the instead of the periphery of the smaller wheel, and, with this reduction ht, the wear and tear will be reduced, and the ease of the motion d. Moreover, the force to be overcome being less with the same load, , by retaining the power of the engine the same, carry a greater load present with the same velocity, or, retaining the same load, carry it ater velocity by increasing the diameter of the driving wheels of the ; or, if it be not desirable to increase the velocity, the speed of the night be reduced, which would be a great practical advantage; or, preserving the same load and velocity, the form and weight of the may be made less, and, probably, the one or other of these arrange- ould be adopted, according to the nature of the traffic on the rail- Thus, in passenger and mail trains, it might be desirable to increase city, whereas, in the carriage of heavy goods, it would be most eco- to increase the load." "But (say the commissioners) there is a hich must be attended to, and that is, that the whole of the advan- pply only to level lines." Now the Great Western was thus suscep- having a wider gauge, since the line was made nearly level, for, as missioners observe, "in ascending the various gradients and inclined the load has to be raised in opposition to gravity, and the power ry to effect this is frequently equal to, or exceeds, that which is em- to overcome the friction, and will remain the same to whatever ex- friction is reduced. To avail ourselves fully of the reduced friction, lanes which cannot be worked by assistant power require to be re- n their slopes, in the same proportion that the wheels are increased, rwise, that assistant power be applied on proportionably less slopes cording to the present practice"—that is to say, that the power of ine is employed in overcoming the friction of the load, and in raising e several ascents, and what is gained by increasing the breadth of way and making the wheels run outside the frames, is only applicable former, the latter remaining the same as before; "and the advantage lteration would be overrated if this circumstance were not taken into ration." Thus it is that the additional advantage arising from the ion of friction is so small, when you come to other than nearly hori- ines, that the advantage is lost. There is yet another reason for ng the gauge—viz. that we are enabled to construct the machine being cramped in space for the moving parts, and affording a larger r for the boiler; it was this consideration, probably, which first in- ractical engineers to pay attention to increasing the gauge above in. If we had to begin railways again, we should certainly make the ider than 4 ft. 8½ in. In laying out future lines, particularly where the not great, the point of consideration will be to obtain the greatest ge at the least expense, and to determine how much the gauge ought creased; and Mr. Vignoles stated, that, after having paid a deal of n to the subject, he gave it as his opinion, that a gauge of six feet e amply sufficient to satisfy all reasonable conditions. The Irish Commissioners had observed, "that, at present, the load is seldom the power of the engine, and, this being the case, but little would d by a greater breadth of road," with a view only of reducing the ce, already much inferior to the power by which it is to be overcome, y allowing an increased speed on the line generally, and on the level n particular. With a full and overflowing traffic, there is no doubt be advisable to employ the greatest possible breadth of bearing; useless, or worse than useless, to incur a present expense for a benefit is not likely that there will ever be the means of taking advantage at, unless under the circumstances just mentioned—viz. an incessant Mr. Vignoles thought that a seven-feet gauge was over the mark. noles stated, that the consideration of curves was connected with he gauge, that it was a most important element in the consideration ays, and would be taken up in another lecture. The rule given for he outer rail, on curves, required the gauge to be included as one in the calculation, as also the height of the centre of gravity above , which was also contingent on the gauge, as before explained.

INSTRUMENT FOR CALCULATING VELOCITIES ON RAILWAYS, &c.

(With an Engraving, Plate IX.)

The instrument represented in the annexed plate, which I have named a "Velocimeter," is intended to supersede the long calculations, frequently necessary, in obtaining velocities in engine trials.

When the times of passing the quarter mile posts only are noted, such an apparatus is hardly called for, since, the distances being constant, a table may readily be made out which will give the velocities due to the different times; but it is a common practice, and perhaps a more satisfactory one, to note the times taken in traversing the several gradients, where the distances as well as the times are variable. The lengths of the inclines are generally fractional, and probably no two are the same, and none of the times of travelling over them are equal; consequently each case involves a distinct calculation, and where the trials have been extensive, several days may be occupied in making these reductions. It is, therefore, a desideratum to have some other means of obtaining the velocities, than that afforded by the ordinary methods of calculation.

The instrument devised for this purpose, is another application of that very important geometrical principle—the equality of the ratios of the sides of similar triangles. In the right angled triangle A B C (Fig. 1), let A B be taken to represent any given number of minutes and seconds, and A C the number of miles and chains passed over in that time. Then, if A B be produced until it becomes equivalent to an hour, and from its extremity D, a perpendicular be drawn intersecting A C produced in E, A E will represent the number of miles that would have been traversed in the hour had the motion been continued, that is, it will indicate the rate per hour at which the distance A C was travelled. Now, if A E be made to revolve round A, and to take any other positions, as A E' or A E," it is clear that the relations will still be the same, and that if any distances A C,' or A C," be described in the time A B, A E' and A E" will indicate the respective rates per hour. If, in addition to this, B C be made moveable along A D, or, what is the same thing, if A D be divided into minutes and seconds, and lines be drawn from the divisions parallel to B C, we shall be able to adjust the revolving line, to any distances and times, within the limits that may be allowed by the arrangement.

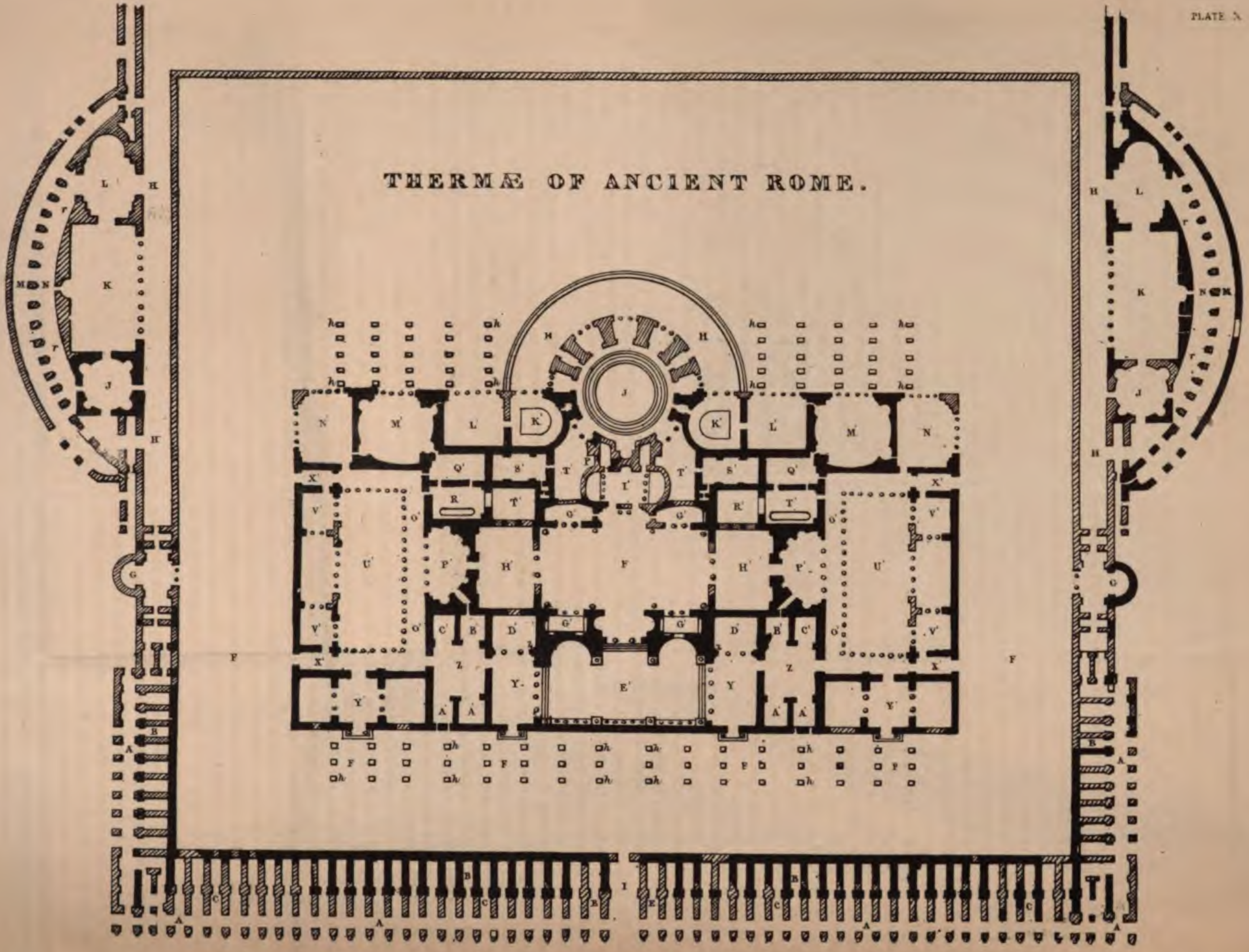
It will probably be objected, that if the line A D, representing an hour, is to be divided into minutes and seconds, its length must be so great as to make the instrument too unwieldy for common use. This difficulty is, however, very readily surmounted.

If A D (Fig. 2), be taken to represent a quarter of an hour, instead of an hour as in the last figure, it follows, that other things being the same, A E will represent one-fourth of the number of miles per hour; that is, if A E had four times the number of divisions, it would indicate the rate per hour: if, therefore, A E have two scales, one for adjustment and the other with divisions one-fourth the size for indication, the velocities may be read off as before. Or if it be desirable to make use of one-tenth of an hour, instead of one-fourth, we have only to make the indicating divisions, one-tenth of the size of the adjusting divisions, and the same result will follow.

In the application of this principle to practice, the following arrangements are made:—A D is the scale of time, embracing in this case one-tenth of an hour, or six minutes; each minute includes 15 divisions, one of which will, therefore, represent 4 seconds, and as each of these may be readily bisected by the eye, the scale may be considered as divided into periods of two seconds each. A E is the scale of distance, turning on the centre A, the adjusting scale being divided into 4 miles, and each of these subdivided into 80 chains; the same space is divided on the indicating scale into 40 miles, and each of these into eighths, ten miles on the one scale being equivalent to one on the other, in consequence of the time scale extending only to one-tenth of an hour.

To obtain results by this apparatus, the revolving scale is moved until the division answering to the number of miles and chains passed

THERMÆ OF ANCIENT ROME.



seeing them is concerned, might just as well have been hung with their faces towards the wall, and have had their titles written in large letters on their backs.

Having mentioned Mr. Barry, we will now speak of his two interiors, Nos. 1030 and 1040, the intended Royal Gallery and St. Stephen's Hall, in the New Houses of Parliament, which are admirable as architectural pictures, masterly in execution, carefully made out in detail, without being prim or tame, and freely touched and full of effect, without that effect being at all strained or exaggerated. On the other hand, the architecture itself is pictorial and scenic; rich, but chaste, and consistent in character. Yet it is a question with us whether these drawings will satisfy the expectations of all who look at them for the effect of the proposed mode of decoration with fresco-painting,* the spaces intended to be so filled up being nothing more than a series of moderate-sized compartments, in which oil pictures or pieces of tapestry might be inserted. Except, then, those panels form part of the architectural arrangement, and are provided for painting, there is no pictorial embellishment.

Nos. 1019 and 1055, two very forcible and clever perspective drawings, showing the interior and exterior of the church now erecting at Wilton near Salisbury, by Messrs. Wyatt and Brandon, are sufficiently conspicuous, and are remarkable, not only on account of the unusual style made choice of, but for the equally unusual liberality with which the design seems to be carried out, so very different from that of the "greatest accommodation at the minimum of cost" principle adopted of late years, and which has covered the country with cheap churches, which it would be complimentary to compare to barns, they being far more unsightly—crammed with pews and galleries, for the purpose of packing a congregation together within the smallest possible compass. In proportion to the space it occupies, the Wilton church affords comparatively very few sittings; and is, besides, so uniformly decked out, and that in a manner quite contrary to established regulations, that we cannot for a moment suppose the Church Commissioners or other authorities to have been concerned with it, or that there was any competition, and a programme from a committee on this occasion. Whether the style—which is a mixture of the early Italian or Lombardic with Norman—was suggested *by* or suggested *to* the architects, we know not, but they certainly appear to have had a *carte blanche* afforded them, and to have been not at all stinted; whereas stinting and stinginess usually manifest themselves most disagreeably in nearly all our recent ecclesiastical structures, for if they make any pretension to architectural design externally, they are chillingly naked and bare within, or *vice versâ*; else are they equally insipid and mean throughout. There are no indications here of the design having been pared down, and we hope that such operation will not or has not taken place in the building itself. The design, indeed, is not so entirely satisfactory that it would not have borne any additional study; but scarcely ever does it happen that the afterthoughts adopted for a building during its progress are improvements or corrections—rather quite the reverse. The omission of those ornamental expletives which, whatever share they may have had in influencing the first choice, are, on *maturer consideration*, rejected as superfluous redundances, allowed to pass in the drawings, because nothing is easier than to omit them in the building itself. The lofty square campanile at the north-west angle, detached from the church itself, except as connected with it below by a short corridor forming an internal communication between them, is not only a very marked feature —one which gives variety as well as importance to the whole exterior —but being so placed, serves to extend the front very much; and we, therefore, think its position in the plan better than that of the Streatham church campanile, which is attached to the apsis end of the building. The front itself has a good deal of rich and characteristic detail: the decorated porch below, and the large wheel window above, tell well in the design; but we apprehend that the red tiling—especially that strip of it forming a penthouse covering to the projection of the lower part of the front, within which the entrance or porch is recessed—will produce a rather crude and disagreeable effect in execution, and have a too homely, if not a positively mean and vulgar, look.

With No. 1038, "The County Assize Courts erecting at Cambridge," by the same architects, we are not so well satisfied. The style is Italian, and the composition a Doric order in pilasters, with seven intercolumns or compartments, five of which are filled in with open arches resting upon detached columns of a lesser order. The loggia thus formed gives both character and picturesque expression; still the ensemble is neither particularly happy nor particularly original. It looks too much like a mere architectural reminiscence, without any attempt at individuality, and without much study as to detail. It strikes us, also, that the whole façade is by far too low—at least, such is the idea conveyed by the drawing, which, it must be owned, is not a particularly agreeable one, being exceedingly heavy in its shadows.

Nos. 1027 and 1050, are drawings of the Moorshedabad Palace. An elevation and plan of the Palace appeared in the Journal for May last.

No. 1037 shows us Mr. Elmes' building for the Law Courts at Liverpool, from the same point of view as the outline wood-cut drawing of it in the last volume of the *Companion to the Almanac*, but with some subsequent alterations in the design, the chief of which is that the southern portico will now be octastyle, diprostyle, instead of hexastyle, monoprostyle. It further appears, from the small plan, that the semicircular projection at the North end—a drawing of which we should like to have seen here—is considerably enlarged. But if so far there is some improvement and amplification, we perceive also that there is now some retrenchment in regard to decoration, for instead of the screen between the square pillars in the lateral divisions of the East front, having panels with subjects in bas-relief, there will be no other sculpture there than a single large wreath in each compartment, and even that may probably be eventually omitted. We regret this change in the design, for we would rather have seen something added in regard to sculpture and embellishment than the contrary. Of display with columns there is enough, a very unusual and striking degree of it, so much so that something is wanted to produce consistent richness in other respects. Therefore, if instead of adding more columns to the South portico, its pediment had been filled with sculpture, and the reliefs on the other parts abovementioned had been retained, the whole would have been materially better, a much finer piece of architecture, and of very superior quality, whereas now the quality at first promised will, we fear, be greatly abated. However, although it will not be made so much of, as the drawing and description in the "Companion" led us to expect, there will, at any rate, be one novel and happy idea in the composition, namely, the square pillars with screens between them, which, as may be seen by the present drawing, will produce a piquant effect, and serve to carry on the order uninterruptedly throughout, at the same time avoiding that wearisome monotony which it is so difficult to avoid or get rid of in Grecian architecture, without breaking up the composition, or introducing irrelevant features that more or less jar with the colonnaded portions of the design.

No. 1068 is interesting as a representation of the so-much-talked-of embellishments of the Temple Church, and certainly the vaulting of the roof is splendidly decorated in a mode almost unique in this country; yet rich and tasteful as it is in itself, we do not think it either accords with the style of the edifice, or is particularly appropriate to its character. Its gaiety and luxuriance recommend it rather for a ball or banqueting room than for a church, at least not for one which is in other respects almost bare of ornament of any kind. In the building itself the effect may, perhaps, be different—very much better; if not, the cost so incurred might have been spared, and the money more judiciously applied to the improving and embellishing the exterior of the Gothic building in the Temple, facing the garden, which, if it does not need being repaired, certainly stands in very great need of being reformed.

The two drawings by Mr. Ferrey marked Nos. 1081 and 1092, are both, we presume, views of the same building, viz. a house erecting for Chas. Porcher, Esq., at Cliff, near Dorchester, although 1092 is merely called a Design—a mistake, probably, in the catalogue, or in the earlier impressions of it—and it is to that side of the building, or its entrance front, that we give the preference, as being more piquant in character than the other, which, owing to their being so many windows, all very spacious and nearly uniform in size and design, is somewhat too monotonous, and seems to require breadth and repose. Upon the whole, however, it is a very pleasing specimen of the Tudor domestic style.

Of the three drawings sent by Mr. Donaldson, one is so remarkable that we give its title at length from the catalogue; "View of the principal part of an approved design for rebuilding Hallyburton House, Angusshire, N. B., the seat of the late Lord Douglass Gordon Hallyburton, composed in the style of the Florentine palaces and villas, at the express desire of his Lordship." From this explanation it appears that the peculiar style here adopted was entirely of his Lordship's own choosing, and so far the architect is not at all responsible for what we cannot help considering a very unhappy selection, for even what are the merits of the early Florentine palazzo style, discommend it almost more than any other for a modern country mansion, for which purpose it is by far too stern and forbidding, and partakes, moreover, too much of town architecture. Still, although the style was forced upon him, we think there was no occasion for Mr. D. to follow it so closely. Without too widely departing from it, he might have treated it with artistical freedom—might have subdued some of its asperity, and have refined it in many other respects; instead of which, he rather seems to have exaggerated some of its least pleasing qualities. Besides what is mere matter of taste, we should apprehend that the peculiar shape of the windows, viz. two arches resting upon a central column, must not only produce a bad effect within the rooms, but be very disadvantageous in regard to internal character and mode of decoration.

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* In regard to fresco-painting, the present exhibition affords no symptoms of our artists preparing for it. On the contrary, the *lion* in it, Maclise's "Scene from Hamlet," indicates a taste diametrically opposed to fresco, for it is completely in the wax-work style of art—perfect deception, and nothing higher.

No. 1118, "An Elevation of All Saints' Church, Gordon Street," is by the same architect, in a style equally unusual as that of the preceding subject. Disposed, however, as we are to welcome novelty in designs for churches which do not profess to be in the Gothic style—to welcome almost anything in preference to the customary common-place portico, generally very ordinary in itself, and thrust forth is a sort of apology for the general architectural slovenliness—we cannot say we greatly relish this specimen, and we relish still less its execution in the drawing, for in the building the shafts of the pilasters are not of stone like the other dressings, but merely of brick, owing to which and to their projecting so very slightly from the face of the rest of the wall, they are scarcely visible, distinguish themselves neither by difference of colour and surface, nor by shadow, therefore their capitals look only like so many patches of carved stone, disconnected from every thing else. What would Mr. D. himself say to columns with only their capitals in stone, and their shafts of brickwork? Most probably he would call it a great solecism in taste; and in our opinion he has committed quite as great, if not a greater one, because, at all events, the shafts of such columns would show themselves distinctly, which is not the case with those of his pilasters. The front of the church in Gordon Street exhibits far more of niggardliness in saving the paltry difference of cost between stone and brick for the pilasters than of the economy of design, for though it was deemed expedient to adopt such homely material for what are important parts in the decoration, there are three small circular slabs of coloured marble introduced in the frieze, which produce no other effect than so many small windows or pigeon-holes. There is also a good deal of carved stone work over the doors, difficult to be described, for though supplying the place of pediments to them, those large arched ornaments are altogether different from any sort of pediment. If, therefore, retrenchment was necessary at all, we think it might have been applied to these extraneous pieces of decoration, which might have been either reduced to pediments of the usual form, or omitted altogether.

1097. "Storehouses and other buildings, designed for a public company," by E. B. Lamb, is so unfavourably placed as to be in danger of being quite overlooked. It is, however, worth while stooping down, to obtain a sight of it, for it shows how much valuable effect may be produced with the simplest means by nothing more than artist-like arrangement and management; we say "nothing more," yet that nothing more seems to be very far more than architects in general can accomplish, or even seem to aim at. While so many of our public buildings, and those not the least costly ones, are, in the quality of their architecture, little better than warehouses or barracks, as, for instance, the exterior of the new portions of the British Museum, we here perceive how even storehouses might be rendered tasteful and highly picturesque architectural objects; and were the banks of the Thames lined with warehouses and storehouses similar in style to those here designed by Mr. L, the view from the bridges and from the river would afford a finer succession of architectural scenery than any other part of the metropolis. If we want a striking contrast to this, in point of taste, we have only to turn to

No. 1119, "The North and West Fronts and the Interior of the First Quadrangle of the Royal Naval School, as approved by the council and proposed to be built at Counter Hill, Deptford." J. Shaw. This is a mere red brick house, full of windows, of most dismal physiognomy, and without any sort of pretension to architectural design; therefore it has no pretension to be thrust into an exhibition room—more especially one where room itself is so scarce that many things far more worth seeing, are thrust out of sight.

On No. 1139, with its stately Corinthian portico, first catching our eye, we had no idea that it could be other than a mere design, and were, therefore, very agreeably surprised to find, on referring to the catalogue, that it is the representation of the "Wesleyan chapel, &c." now erecting at Kingston-on-Hull, for it has certainly a far more classical look, and is withal a more varied composition, than anything similar in style in our own church architecture. Besides being an octastyle, the portico has an inner recess, with two columns in antis, whereby it acquires a very unusual degree of effect and richness, which is further increased by the whole being raised on a stylobate terrace, out of which is cut a flight of steps forming the ascent to the portico. On this terrace are two lower buildings or wings (for the sacristy and keeper's house,) connected with the central one, by open colonnades of the Grecian Doric order. Picturesque, however, as are the arrangement and combination in this respect, we must confess we are not altogether satisfied with the design of these wings. The elevations of their sides towards the portico (with a door between two windows in each), sadly impair the general effect, and have too much the look of ordinary park lodges: the windows should be omitted here altogether, and placed on the other side. Neither is the lesser order so good as it might be, and the columns are so far apart that it looks poor and straggling, and produces a disagreeable contrast with the central portico. In fact had the lesser order been Ionic, it would have combined far better with the Corinthian one: Messrs. Lockwood and Allom would have done well—or we may say, would have done better than they now have—had they bestowed a few second thoughts and corrections on this design.

The Wesleyans seem to be now vying with the Catholics in new structures and show of architecture, for the very next No. (1140) is "The Wesleyan Theological Institution, now erecting at Richmond, Surrey." Who Mr. A. Trimson, or Trimen, for his name is spelled both ways in the catalogue, may be, we know not, but he certainly recommends himself to us not a little by this specimen of his taste. The style is the later Gothic, and the character collegiate, with some degree of novelty also in the arrangement, there being a range of spacious and more than ordinarily ornamented windows on the lower floor, with two series of chamber windows above them.

Among those drawings which we did see, but which we have not noticed, is No. 994, "A Royal Academy for the fine arts, including a National Glyptothek and Pinakothek," by C. Tottie; nor should we mention it now, were it not to express our astonishment that such an Alexandrine-verse design, "dragging its slow length along," should have found any one to admire it. Remarkably poor and insipid in itself, it is spun out to most wearisome monotony, for it is little more than a mere string of Corinthian columns, with two rows of *arched* doors and windows between them. It is just such another piece of architectural insipidity as the front of the Royal Institution, Albemarle Street, or that of Chester Terrace, in the Regent's Park—monstrously prolix, exceedingly lengthy, very drawling, and intolerably dull. This is an ungracious conclusion to our remarks, but there is no help for it, for here conclude we must, unless we choose to risk the chance of being *ex*cluded from the present number.

ELECTRO-MAGNETISM AS A MOVING POWER.—The Consul-General of the Netherlands, in a communication dated the 18th April, thus announces the removal of the hitherto greal obstacle to the practical application of electro-magnetism as an effective propelling power:—"A private gentleman, M. Elias, of Haarlem, has just published the description of a new machine invented by him, for the application of electro-magnetism as a substitute for steam. The object of the inventor has been chiefly to remedy the defects which, in 1839, rendered the otherwise ingenious invention of M. Jacobi, of St. Petersburgh, a fotal failure, in as far as practical utility is concerned. Those defects originated, it seems, in the erroneous supposition that the power of the magnetic bars exclusively resides in their extremities, whence the form hitherto given to all electro-magnetic machines—viz. that of a horse-shoe—which, while it occasions an unavoidable interruption of the magnetic stream at each new inversion of the poles, at the same time leaves the power resident in the remaining part of the bars wholly unemployed. The new invention of M. Elias, on the contrary, has the very great advantage of rendering effective the full power of the magnetic stream uninterruptedly, and throughout the whole body of the apparatus. This consists of two concentric rings of soft iron, standing on the same plane, of which the external one is immovable, while that on the inside revolves round its own axis. By means of a piece of copper wire, wound about each of these rings, he has given them six magnetic poles, placed at equal distances from one another, the whole being so contrived that the one ring exerts its inducing power on the other throughout the whole circumference, and always at the same distance. A small but very perfect model of this important invention is now open to public inspection here; and the result of its operation is allowed, by those skilled in such matters, to be such as to insure the most triumphant success."

REVIEWS.

Architecture of Machinery; an Essay on propriety of form and proportion, with a view to assist and improve Design. By SAMUEL CLEGG, Jun., C.E. London: John Weale, 1842.

IF the execution of this work had been at all answerable to the interest of the subject it professes to discuss, our present task would have been a more agreeable as well as a more simple one. But after a diligent perusal of Mr. Clegg's essay, we find ourselves unable to resist the conviction that its author has failed in his object, and that the consummation which this essay was intended to bring about is just as remote as ever. We feel it, therefore, in some measure incumbent upon us not merely to enter a protest against the heresies into which Mr. Clegg has fallen, but, so far as our limits will permit, to relieve the necessities his essay was meant to extinguish.

We perfectly agree with Mr. Clegg in thinking that the beauty of a piece of machinery is a consideration by no means unimportant, and it is one in our mind second only to the qualities of efficiency and convenience. We believe, with Mr. Clegg, "that the majority of those for whom machines are constructed cannot enter into the merits of their internal action, or of their comparative performance; and, therefore, not being willing to yield the right of opinion, judge from outside show, as they would of a picture or statue, where the only aim is to charm the eye, or excite pleasurable sensations in the mind." We think also that "It may, therefore, be inferred that in many instances the want of elegance in the contour of a machine is not only displeasing to the spectator, but disadvantageous to the manufacturer;" and we believe that it is disadvantageous to the manufacturer because popularly displeasing. But we cannot assent to the legitimacy of the conclusion deduced by Mr. Clegg from this proposition: we do not think it follows that, where architectural contour is unattainable without the infraction of architectural rules, it will, therefore, be the best or even the most popular course to adhere to the mechanical contour merely, or be content with those unadorned forms which science indicates as the best for withstanding the strains to which machinery is subjected. The selection of such unembellished forms we may suppose would be made by the accomplished mechanician, who would probably see in their superior scientific fitness an ample compensation for their destitution of ornament; but we can scarcely suppose such inducements to be operative with those who, without any pretensions to scientific capacity, are nevertheless disinclined to surrender their right of judgment, but judge of an engine as they would judge of a picture or statue. Upon such persons all evidences of nicety of scientific disposition must manifestly be thrown away; and they will in general esteem that to be the handsomest design which is the most exuberantly embellished. It is quite true that many of the designs to which a preference so regulated will be given must probably be ungraceful and incongruous; inconsistent perhaps with every principle of good taste, as well as with every established principle of science. But this only argues the absence of good taste among those who are pleased with such barbarisms, at the same time that it shows they are solicitous to gratify a sentiment which to them stands in the place of it. Nor can we be astonished at this depravity of taste among the multitude, when we remember how rankly it flourishes among those even with whom science is familiar, and reflect that taste is the resultant of an infinitude of influences, each slight in its individual character, and too remote and evanescent to be determinable by rules, or be susceptible of reduction to any empirical form of expression. The great majority of mankind are not only destitute of that natural sensibility upon which delicacy of taste can alone be engrafted, but are often unpossessed even of that knowledge which is necessary to enable them to distinguish glare and extravagance from true sublimity. To the less obvious or obtrusive beauties they will be insensible; they will derive pleasure from what is distasteful to those of more cultivated understandings, and will often mistake imperfections for excellence.

It appears to us then that Mr. Clegg's argument, instead of proving the propriety of engineers adapting the exterior of their machinery to the taste of their customers, rather shows that the customers ought to improve their taste, or not intermeddle. But at the same time we find that Mr. Clegg, in opposition to his own precepts, recommends a style of machinery the alleged superiority of which rests upon qualities which science alone can illustrate, and which the commonalty can neither appreciate nor comprehend. There is much inconsistency, we think, in this part of Mr. Clegg's dissertation. He first tells us, p. 2, that an attention to outside show, or, as we understand it, to embellishment, is highly expedient, whilst in p. 3 he deprecates the use of any ornament whatever. "If," says he, "those parts (of machinery) are made in such a manner that they have strength in the proper place, stability without unnecessary weight, and simplicity of form without meanness, they require no other ornament, because their own proportions will constitute their greatest." We confess this looks very much like a riddle to us. The embellishment of machinery either is or is not expedient, and we should have been thankful to Mr. Clegg, had he stated a little more clearly to which doctrine his opinion inclines. From the examples of marine engine-framing which he recommends, and other circumstances, we conclude that he is hostile to the introduction of any embellishment whatever, on the principle, we presume, that that which contains everything necessary and nothing redundant is the most fit, and consequently the most beautiful. If this be Mr. Clegg's creed—and we believe that it is—we must say that we think it a very preposterous one. Fitness, though a constituent of beauty, is not the only constituent: disproportion will, it is true, give pain, and symmetry will confer pleasure; but many things, though perfectly well proportioned, and excellently adapted to their intended purposes, have very slender claims upon our admiration on account of their beauty. A barracks or a cotton mill may be as well adapted to their respective ends as St. Paul's or the Parthenon, but who would, therefore, pretend that they were equally beautiful? In like manner, an engine with a wooden beam or wooden framing, and with the malleable iron work, with the exception of the rubbing parts, just as it left the smith's anvil, may be as scientifically constructed, and in every respect as efficient as the most highly-finished engine that ever was manufactured. But who would, therefore, be prepared to maintain that it must necessarily be as handsome? We differ entirely from Mr. Clegg, in regarding fitness as synonymous with beauty; at the same time we willingly admit that beauty can never exist in perfection where fitness has not been scrupulously attended to.

In p. 16 Mr. Clegg favours us with the following definition of taste, which appears to us liable to exception:—"By the word Taste is meant that proper and well-directed exercise of the judgment by which a man acquires facility in detecting impropriety of form, and distinguishing with readiness the masterpieces of great hands from the performances of vulgar artists." Now correct taste, we contend, involves not merely the possession of a sound judgment, but of a good deal more. Any mathematician can determine the proper form of a body to resist any given strain, and a man of great knowledge and experience may be supposed capable of determining the best shape and proportion of a structure for fulfilling any required condition. But all this may be settled and the question of beauty remain untouched, and it is only indeed where the dominion of judgment ends that the empire of taste properly begins. Not that there is anything in taste inconsistent with the results which judgment has developed, or even independent of them, but that when science has exhausted her skill, another agency is available to carry us to a still higher pitch of excellence, and to heighten our enjoyment, not by any new evidences of fitness, or by any appeal to our judgment at all, but by calling into activity a multitude of hidden sympathies, and establishing a communion with the most exalted sensibilities of our nature. We do not mean to say that in looking at machinery—whatever be its character—such feelings are likely to be excited in any eminent degree; but whatever pleasure may be derived from its inspection, over and above that due to the sense of its judicious construction and arrangement, is undoubtedly due to their existence. Beauty is not to be estimated by the rule or the plummet, or computed by means of logarithms; and the author of the work before us, by reducing beauty to a mere question of fitness which may be so estimated has, in our opinion, degraded taste from her proper sphere, and proved himself incompetent for the function he has ventured to exercise.

But it is time that we should consider some of the forms of machinery with which Mr. Clegg presents us. Fig. 24 is the framing of a marine engine, as constructed by the Butterley Company; fig. 25 is the marine engine-framing of Boulton and Watt; and fig. 26 resembles the framing made by Mr. Clegg for the City of Londonderry and other vessels. There is no attempt at decoration in any of these examples, and they are all, in our estimation, far from handsome. Fig. 27 is the framing of the Wilberforce, the diagonal stay of which is curved. We agree with Mr. Clegg in thinking this curve disadvantageous, but the object was not, as he supposes, to introduce a large condenser. The stay of the framing of the Royal Tar, by the same maker, is likewise curved, although the condenser is of the usual description; and that framing has stood and lasted better than any with which we are acquainted. Fig. 28 is the framing of the Don Juan; fig. 29 the framing used by Messrs. Seaward; and fig. 30 that at one time used by Messrs. Fawcett and Co., of Liverpool: these three framings are of the Doric order. We agree with Mr. Clegg in thinking that this order of architecture is not well adapted for the framings of steam engines; and, indeed, our opinion is that not one of the existing orders is fitted for that purpose. There is something very unmeaning in columns stuck upon the top of columns, and little columns stuck here and there over the framing, of all possible proportions and dimensions. Nevertheless, although figs. 28, 29, and 30 are indisputably architectural monstrosities, they are in our eyes less displeasing than the vapid and quakerlike arrangements shown in the preceding figures, and we believe that two-thirds of our engineers will be found to be of our way of thinking.

In much of what Mr. Clegg says about wrought iron work we perfectly concur, and we do not anticipate much opposition from engineers to the doctrine that wearing parts should be susceptible of re-adjustment, or that every portion of the moving parts should be made equally strong. We dissent, however, from Mr. Clegg when he says that the arrangement shown in fig. 53 is the most approved system of attaching the ends of rods to their cross heads (tails), and that the arrangement shown in fig. 54 is the one to be avoided. The former method consists in constructing the cross tail with a large oval hole in the centre, through which a pin passes horizontally, and to which pin the end of the connecting rod is attached by means of a strap and cutter. The advantage of this plan Mr. Clegg informs us is "that it allows some play and wear in the brasses, without giving rise to bad consequences." But the bad consequences are altogether imaginary; a few marine engines have been constructed upon this plan, but the provision has been found needless, and no engineer now thinks of employing it, especially as it is reckoned unsightly and more expensive to manufacture. The universal practice now is to attach the connecting rods to the cross tails, in the manner shown in fig. 54, which this gentleman reprehends; and we do not believe that he can adduce a single example of any ill effect having resulted from it. The angular straps shown in fig. 53 are objectionable; they are very liable to crack at the angles, and several of those of the City of Londonderry have so given way. In speaking of side rod eyes Mr. Clegg says "The circular eye, fig. 57, is not calculated for equal strength, nor is the brass bush practically correct, for there is no provision for wear." We are unwilling to believe that Mr. Clegg supposes circular side rod eyes are generally or ever made without any provision for wear; for we cannot suppose any one undertaking to write upon marine steam machinery so profoundly ignorant of the subject as to be capable of entertaining any such supposition. Yet, whilst resisting this belief, we must confess ourselves unable to understand Mr. Clegg's statement on any other hypothesis.

We cannot follow this gentleman further, and have only room, in conclusion, to say that although the several ordinary orders of architecture are unsuitable for machinery—and preposterous it is to copy in iron the lineaments and proportions intended only for stone—yet there may and there must be a species of architecture adapted to this purpose, which, without interfering with the proper disposition of materials, will accommodate itself to existing shapes and conditions, and add the highest degree of grace and refinement; so that, whilst securing the homage of the superficial and uninitiated, it cannot fail to earn the approbation of the most proficient and fastidious. We anticipated from the title of his book that Mr. Clegg would have given us some examples of an architecture of this description, instead of informing us that the first principle of the architecture of machinery is that there be no architecture in it. Cast iron has its appropriate architecture as well as stone, engines as well as cathedrals, differing as much, too, from mere unembellished construction as a barn differs from an abbey. On a future occasion we may perhaps give some specimens of this architecture of machinery; at present we can only say that such an architecture exists, and it is no commendation of Mr. Clegg's essay to say that it leaves the knowledge of the subject precisely where it found it. The plates accompanying the essay are very good, though for the most part superfluous; the wood cuts are excellent, and the typography magnificent. But the thoughts are for the most part trivial and common-place, the reasonings sometimes inconsequential, the statements often inexact, and the style neither very elegant nor very perspicuous. Whatever other branches of knowledge Mr. Clegg may be skilled in, it is plain that his acquaintance with the structure of steam machinery, as well as with the resources of decorative art, is limited and superficial; and we conceive it to be unfortunate for his reputation that he has ventured upon an undertaking which renders those deficiences so conspicuous and so inexcusable.

Memorials of Cambridge: a series of Views, &c.

OF this work, which has now reached its 29th number, and which is, therefore, approaching towards its conclusion, by no means can we report so favourably as we could wish, for instead of manifesting any improvement upon its predecessor, "The Memorials of Oxford," it shows an evident falling off in the graphic department, many of the views being uninteresting in subject, poor, spiritless, and inaccurate in drawing; and but very *so-soishly* engraved, notwithstanding that the name of J. Le Keux is affixed to them, which is all, we suspect, that there is of his in those we allude to. Mr. Bell is so decidedly inferior to Mackenzie as an architectural draughtsman, that by yoking them together in the same work its character has been rendered very unequal. Even Mackenzie himself has here somewhat disappointed us, several of the subjects by him being not fresh views, but merely repetitions of former ones by himself, and probably engraved from the same drawings as the latter. This ought not to be, more especially as many of the subjects might be shown to greater advantage by being taken from a different point of view. Hardly, too, do we complain very unreasonably, when we allege it as a fault that in some of the views the buildings themselves are shown so remotely as to be very little more than accessories in the general scene; or again, when we say that more than one piece of architecture is here very inadequately represented. In this latter predicament is the Fitzwilliam Museum, of which merely a view of the front is given, and that by no means a very good one, although it bears the name of Mackenzie as the draughtsman.* Yet as this structure is entirely a new one, more than a single drawing of it would have been very acceptable; or, at all events, there should have been one interior view, and if only one, it should have been that of the entrance hall, and sculpture gallery around it. But if little has been done with the pencil towards explaining that important public edifice, very much has been done with the pen in describing it; at any rate comparatively much, for the account of the Museum is almost the only satisfactory piece of architectural description that has yet been given in the course of the work. It is indeed so unlike any of the other "descriptions," that we almost suspect it must have been derived from some other publication; in which case it is a pity that the editors—for there are actually two employed—did not help themselves to more matter of the kind equally good. Yet of description and remarks on the respective buildings there is scarcely anything at all, although such would seem to be an almost indispensable accompaniment to a series of views—to what is a graphic publication of popular character as to size and the mode of getting up, not a library work for the antiquarian student. The "Memorials" smell too much of the laboratory of the British Museum—that admirable national establishment where old books are ground young again—a process that may in time be applied to old women also. Of most undisguised book-making the very last number exhibits a striking specimen; the account is that of Queen's College, and because Erasmus happened to reside there some time while he was in England—a fact that might have been stated in a couple of lines—we are treated with a whole history of him, for it would seem no information relative to him is to be met with in any biographical dictionary or encyclopedia. However, if the learned editors help themselves hugely to such pieces of fat, they give their readers plenty of lean, for nothing can be more meagre, jejune, and scanty, than the information to be here picked up relative to the buildings themselves. What they will say of Downing College and of the new libraries by Cockerell remains to be seen; perhaps it will turn out to be just as much and no more than what they have said of the Observatory. Mr. Le Keux has been most unfortunate in choosing his writers, for they seem to have been recommended to him by that sable gentleman who sends not only cooks, but book-makers.

Appendix C *to the new edition of Tredgold on the Steam Engine and Steam Navigation. Gorgon engines, as fitted on board H.M.S. Cyclops, illustrated by ten plates and descriptive letter press.* By SAMUEL CLEGG, Jun., C.E. London: John Weale, 1842.

THIS is a very valuable addition to Tredgold: the execution of the plates is perfect, and the manner in which the several objects are represented is unexceptionable. The whole of the details of the Gorgon engine are given with the sizes marked upon the several parts, so that the plates are in fact working drawings, from which the things represented might be made. This is precisely what engineers want, and have always wanted; and we are very confident that this work will be most acceptable to the profession, as well as to the public generally.

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* The design is more intelligibly shown in a woodcut view of it in the Athenæum, No. 512, which also contains plans of both floors; and a section of the building and other illustrations have also appeared in the Companion to the Almanac.

But we have higher cause of satisfaction than the excellence of the work. The drawings from which the engravings were made were supplied with the sanction of Messrs. Seaward, the constructors of the engines, who, with a liberality, and we may add a discernment, which do them infinite credit, have allowed the whole details of their engines to be published to the world. We hail this departure from the narrow and futile policy it has been too much the endeavour of engineers to pursue, in making secrets of the dimensions of their machinery, as the harbinger of a better day. The age of secrets is gone; true science and true art recognise nothing cabalistic; and merit should repudiate an auxiliary which empiricism alone does not disdain. But concealment is not only illiberal: it would be inexpedient if it were possible, and impossible if it were expedient. There is no size, proportion, or particular of any engine of any maker which may not be obtained, and which is not obtained by those sufficiently interested in the matter to take the necessary trouble. All therefore that engineers can do is to throw impediments in the way—to render the attainment of the desired information not impracticable, but only more difficult; and this difficulty will in no wise prevent those who are professionally interested in the matter from obtaining that information, however effectually it may discourage and deter those from whom no rivalry is to be apprehended, who have no prominent interest to promote, and whom it is most the interest of every engineer to illuminate. To enginees the publication of the details of the Gorgon engines will carry little information that they did not possess before, and probably among them all there will not be one who will adopt anything more of the Gorgon principle in consequence; for every engineer—even the most unskilful—is apt to consider his own modes of construction superior to all others. But with the public generally, and with steam packet companies in particular, the case is very different. They are in the dark respecting many things; they may have heard disparaging reports in reference to the Gorgon engines, which these drawings may neutralize; they may see evidences of excellence therein of which they had no previous conception; and the existence of these evidences, unbalanced by evidences of the excellencies of other engines, and which other engineers conceal, will greatly contribute to the favourable consideration of Messrs. Seawards' arrangements. The directors of steam packet companies, and indeed all unprofessional persons interested in the operations of steam power, are necessarily very impressible; that is apt to be reckoned the best thing which is the most prominently before them, and to monopolize their attention is almost to secure their preference. It is, therefore, of the utmost moment to every engineer to bring the merits of his work forward as prominently as he can; and there is no more effectual method of doing this than by publishing the whole details of his machinery, without further note or comment than is necessary for making the drawings intelligible. One publication of this kind is better than a thousand puffing pamphlets, for such aids to notoriety are always received with aversion and distrust, and give an unfavourable complexion to the claims of those who resort to them. But an unreserved delineation of the actual parts of machinery, accompanied by an open, unbiassed, and manly statement of the reasons good or bad for the modes of construction adopted, and so explained as to be easily intelligible, can have nothing about it to repel, and it will first secure attention, next reconciliation, and finally probably adoption.

The Architectural, Engineering, and Mechanical Drawing Book, with descriptive Letter-press. London: Weale, 1842.

This work contains many plates of interesting public works, and is well adapted for the use of the younger members of the constructive professions. It consists of three divisions, viz., architecture, engineering, and mechanical drawing, giving numerous illustrations of each on a large scale. The architectural series is of 6 plates, the engineering of 14, and the mechanical drawing of 8, besides two plates of alphabets, &c. The mechanical drawings are particularly useful.

Examples of Encaustic Tiles, Part II. J. B. Nichols and Son.

The author observes that the publication of the first part of his work has elicited so many communications from parties interested in the subject, as to enable him to form the present part principally from such communications. Instead, therefore, of being confined to specimens from Hampshire, the work now takes in other places, including at present Malvern, and the Chapter-House, Westminster; and the author states his intention of continuing the series from Malvern and Gloucester cathedral. The series from the Chapter-House, Westminster, communicated by Mr. Cottingham, is highly interesting: some of these tiles are of very complicated design.

Practical Essay on the Strength of Cast Iron and other Metals. By Thomas Tredgold. Fourth Edition, with Notes by Eaton Hodgkinson, F.R.S. London: John Weale, 1842.

Tredgold's work on Cast Iron has long been admitted to be the best work upon the subject, and most deservedly has it maintained its rank for the accuracy of the tables. It is, therefore, quite unnecessary for us now to enter into the merits of the work before us. In bringing forward a new edition, Mr. Weale has done well in selecting an individual so eminent as Mr. Hodgkinson, for the purpose of editing it. He is well known for the many important experiments which he has made on iron, and which are published in the Transactions of the Royal Society, British Association, &c., all of which we hope to see in the second volume of this work. When this second volume appears, we shall not fail to notice both volumes very fully.

KIDDERMINSTER NEW CHURCH.

Sir—My attention has just been called to a letter in your journal of this month, by Mr. Wardell, strongly animadverting upon the proceedings of the Building Committee, in reference to the new church at Kidderminster, charging them with disgraceful chicanery in their mode of discharging their duties, and intimating that they never intended to act impartially between the competing architects.

Now, Sir, my plan being that originally and unanimously chosen as the best among all the other competitors, and as its eventual rejection by the Committee on the ground of its excess over the stipulated estimate in a great measure caused the unusual delay Mr. W. complains of, perhaps you will allow me very briefly to state the facts as they occurred, which, when fairly considered, place the impartiality of the Committee's intentions beyond all doubt. I may add that the fact of my plan having been originally chosen, and subsequently to my deep regret relinquished, renders me at all events an unexceptionable witness to the honour and the integrity of the Committee.

The designs were sent in on the 21st of December last: ten days afterwards my plan was pronounced the best, and I was empowered to make out working drawings, with the understanding that the final adoption of the design was to depend upon the estimate not exceeding the advertised sum. I can truly testify, that in this stage of the business, in the interviews I had with the Committee, nothing appeared more constantly before their minds than the desire to act fairly and impartially to all; and when it is remembered that their respected chairman was the Rev. T. L. Claughton, the vicar, quite a sufficient guarantee is afforded that nothing unfair would be either attempted or practised.

I was allowed a month to prepare working drawings. They were sent in Feb. 4th, and tenders from builders were advertised for in the Worcestershire papers, to be forwarded by the 1st of March. The opening of these tenders showed a considerable excess in the estimate, and the Committee, in consequence, very reluctantly felt themselves under the necessity of relinquishing my design—a proceeding of which I could not reasonably complain, however much I might regret it, since it was only in pursuance of an arrangement to which I had been a party. Three other designs having been chosen with mine, and Mr. Alexander's standing second, that gentleman was next elected; and as, upon the receipt of the tenders on the 18th of April last, the estimate came within the £3000, Mr. Alexander was appointed as the architect to the church.

These, Sir, are the simple facts of the case, and your readers will, I think, see that there is no foundation whatever for the insinuations of Mr. Wardell. I do not undertake to say that the Committee were altogether justified in keeping the drawings of the whole body of the competitors 15 weeks without any explanation till they made their final decision, but I only desire to assert, which I do from actual knowledge, that the strictest impartiality governed their proceedings, and that their uniform aim was to do justice to all, and give undue preference to none.

I am afraid this letter will hardly reach you in time for your July number; but as its object is to vindicate a body of gentlemen as I think unjustly attacked, I trust you may be able to find space for it.

I am, Sir,
Your obedient servant,
251, *Oxford-street.* Frederick Francis.

P.S. I have said nothing about the possibility or prudence of attempting to build a *good* church to hold 1200 persons for £3000: that is another question, irrelevant to the present correspondence.

[We have also received a letter from Messrs. Starkey and Cuffley, of Manchester, on the same subject, who were competitors. They likewise confirm the impartial decision of the Committee.—Editor.]

ROYAL ACADEMY EXHIBITION.

Sir—Under an impression that any incident, however trifling, connected with the publicity of architectural works may be useful to some of your readers, and not uninteresting to any, I offer for insertion in your next Journal the following facts.

At the usual time for sending in pictures and drawings from which to select for the public Exhibition of this year, a perspective view of an extensive villa, which has recently been erected, and universally admired for its picturesque effect, was forwarded by the architect from a distant county, and in due time reported to be admitted. During the season the architect himself, being in London, searched in vain for this drawing in the Exhibition room; and, in reply to a consequent inquiry into the cause of its omission, was led to a back staircase, where, among many others, he recognised his *admitted drawing* quietly reposing in a corner, and having on its frame the marks of the cramps by which pictures are usually affixed to the walls, proving, of course, that it had actually been hung up. The only explanation that could be obtained of this mystery was contained in a note, stating that "in consequence of the unusually great number of works that had been sent, it was impossible for the Committee of Arrangement, with every wish to do justice to the author's talents, to find a place for his picture." It certainly is neither a miniature nor a portrait, any more than No. 992, *Pickford's Warehouses!* which I suppose is *meant* for an architectural subject!

I am, Sir,
Your obedient servant,
16*th June*, 1842. The Architect.

INSTITUTION OF CIVIL ENGINEERS.

Mr. Walker, the President of the Institution of Civil Engineers, gave his annual, conversazione, on Saturday evening 4th ultimo, and as usual in addition to a most hospitable reception and good fare, supplied ample food for curiosity by a remarkably well selected collection of works of art, and models of machinery, all of which our limits will not permit us to particularize. The Admiralty, with becoming liberalty, sent several of their beautiful models of men-of-war, showing *the superiority* of the mode of construction introduced by Sir William Symonds, and his talented assistant Mr. Edye; near these were appropriately placed a collection of models of improved marine engines, by Maadslays and Field, Miller, Seaward, and Fairburn. From among the multitude of other models may be selected Dockray's self-acting signal for Railways; mallets for raising ships; the Maplin Lighthouse, by Messrs. Walker and Burgess, bridges by Gravatt, Roe's arrangements for cleansing sewers; Captain Reid's water-wheel, Oldham's machine for numbering bank notes. Cheverton's mechanical carvings in ivory, and Braithwaite's pressed carvings in wood, exhibited the close alliance existing between the fine and mechanical arts. Dent's astronomical clock, made for the Emperor of Russia, and that with Professor Airy's new escapement, attracted much attention, as did also the models of Wilton Church, and the Cambridge Courts by Salter, from the designs of Wyatt and Brandon; and that of Railton's, Nelson Memorial Column, with the simple and mechanically contrived scaffolding, with which Grissell and Peto are now erecting it. A bugle horn covered with platinum by means of M. Ruolz's electro-galvanic process, showed a very successful substitution of a chemical for a mechanical process. First among the specimens of the fine arts, must be placed Thomas Landseer's beautiful engraving of Miss Power. Some portfolios of spirited sketches by Nixon, and by Oliver and Tathams, Bailey's busts of Fuseli; and Stoddart and his model group of charity of course were admirable, and it was scarcely fair to place so near them the busts of the President and Mr. Sibley, which were modelled by J. E. Jones, in which however, so much talent was displayed, that he has little cause to be distressed at any comparison, especially as we learn that he has hitherto laboured with amateur love of the art of modelling, being professionally a Civil Engineer. The principal model room was brilliantly lighted by Faraday's light, the same as that which illuminated the Throne-room at the Queen's late fête. Defries exhibited his ingenious dry gas meter in the same room, and the other rooms were lighted by Wilkins's dioptric lamps, and Cross and Blackwell's improvement upon Palmer's candle lamps.

The attendance of the Council and Members of the Institution of Civil Engineers, and also the Architects, was very numerous; there was also a very large number of visitors, many of them of high rank and distinction. The Duke of Wellington, we observed, made a complete circuit of the rooms, and examined every thing with much interest. Among the distinguished visitors we noticed particularly, the Marquis of Northampton, the Earl of Devon, Lords Bexley, Lowther, Mounteagle, Blaney, Baron Rolfe, &c.

ON THE SUPPLY OF WATER FROM THE CHALK BASIN.

This question has assumed such a decided character of partizanship, that we cannot allow it to remain any longer unnoticed, particularly after the recent exhibition of misstatements, garbled reports, and suppressed facts. We shall this month confine ourselves to the publication of the valuable report, being the second, by Mr. Robert Stephenson to the Directors of the proposed Company for supplying the metropolis with the pure and uncontaminated spring water from the chalk basin; and in our next number we shall enter fully into an examination of this important question, and expose the fallacious representations that have been issued to the public.

Mr. Stephenson's Second Report.

In my former report (see *Journal*, Vol. IV, p. 1,) I endeavoured at some length to explain the views which presented themselves to me, during an examination of the experiments made near Watford, for the purpose of ascertaining to what extent the metropolis might be supplied with water from that neighbourhood, by means of sinking shafts into the chalk formation, below the level of the valley of the Colne. In addition to a mere statement of the results, I deemed it necessary to point out some peculiarities which I conceived the chalk formation to possess, and which rendered it, in my opinion, well calculated for yielding a steady and abundant supply.

Since the publication of these views, I have lost no opportunity of carefully studying the remarks which have been made, and the objections which have been urged against the positions I then established as the basis of my opinions.

Some of these replies to my report have assumed the form of pamplets, which separately I have not time, even if I had the inclination, to answer; but in now laying before you the results of the further inquiries, which at the close of my last report I suggested should be undertaken, to confirm or refute my opinions, I am necessarily led to notice such of the statements as appear calculated, either by the authority from which they emanate, or the plausibility with which they are adduced, to affect the views I had taken, or the conclusions which I had drawn from them.

Amongst the assailants of my opinions, are some anonymous writers; and though I feel that such a mode of attack places opponents on the vantage ground, inasmuch as they possess the privilege of making statements totally inapplicable to the matter at issue, or calculated to lead to fallacious conclusions, without subjecting themselves to any responsibility; nevertherless, in the present report, I am bound to overlook the motives by which it may be supposed some of my opponents are actuated, and while I acquiesce in such of their objections as appear well founded, to repel those which are either inapplicable, or contradicted by circumstances which have come under my own knowledge.

The pamphlet which claims my first attention is from the pen of Mr. Webster, and I give it this preference for two reasons; the first, because Mr. Webster's name is one of repute in the scientific world, and whose researches, during the early advances of geology in this country, greatly extended the knowledge of the recent formations of our Island; and the second, because it strikes at the very root of the opinions I endeavoured to expound in my former report. Both his name, therefore, and the wide and essential difference in our views, suggest the propriety of selecting his pamphlet for free and unreserved discussion; for if his statement be consistent with existing facts, the opinions which I have advanced must be erroneous, and farther consideration of your project entirely useless.

Mr. Webster denies, emphatically, that the chalk underlying the stratum of London clay is the "great water-bearing stratum," and would induce the inference, that I had mistaken the true source of supply to the numberless Artesian wells which are sunk in the metropolis and its neighbourhood. He seems to arrive at this conclusion, from my not having dwelt particularly on the "sand and plastic clay stratum," which reposes between the chalk and London clay; whereas I consider the stratum to which he alludes not the "great water-bearing stratum," but merely a subordinate member of that which may be so called.

Both the chalk and sand are extremely porous, and there can be no question that each of the "belts" of country occupied by their outcrops contributes alike its share to the supply of the great reservoir of water covered by the London clay.

In the construction of Artesian wells in or about London it is obvious, therefore, that the supply does not come immediately from the plastic clay sands; but this does not militate against my conclusion, that the reservoir formed by these sands is supplied principally by the absorption of rain, through the medium of the chalk, which occupies far more extensive areas than the plastic clay sands, and consequently possesses (even though it may not be so porous as sand) infinitely greater powers of absorption.

Mr. Webster then proceeds to state, that where wells are sunk through the London clay into the chalk, the water which the latter yields is most probably derived from the water-bearing stratum" above it.

That this was the case in the Hampstead-road well (the instance quoted by Mr. Webster), I am not prepared to deny, though I much doubt the fact; but it cannot be considered conclusive against the supposition of chalk being extremely porous and absorbent, especially as innumerable examples may be referred to in every district occupied by the chalk, as incontestable evidence in its justification; moreover, many instances exist, even in London, where the supply of water to wells sunk to the plastic clay sands having proved insufficient, it has become necessary to sink them into the chalk, when an increased supply has been invariably procured; for example, in the wells at Messrs. Meux and Reid's breweries, at those at Greenwich Hospital, and Mr. Nicholson's distillery, the necessity has arisen, and been met successfully by such a process. And since no particulars can possibly be given of the sinking into the chalk in the Hampstead-road well, no general inference as to the contents and capacity of that formation should be drawn from it, more especially as other examples, upon a much larger scale, such as those above mentioned, may be quoted to prove that an augmentation in the feeders is immediately consequent upon penetrating the chalk below the sands.

I am well acquainted with the chalk district between Watford and Tring, and it having devolved upon me, in the course of my connexion with the London and Birmingham Railway, to sink a great number of wells in the chalk, my attention has been particularly called to the extraordinary quantity of water existing in the chalk immediately below the level of the natural drainage of the country—that is, of the adjoining streams, and I was at the same time struck with the conformity apparent between the surface of the subterranean reservoir of water and the natural surface of the country.

The evidence which the valley from Watford to Tring affords in reference to this point, is replete with interest, for it establishes beyond all question that the water absorbed by the chalk is held up to a very high level towards the edge of the basin; indeed, there is sufficient evidence in the district just mentioned to prove that the surface of the water absorbed by the chalk assumes an inclination corresponding almost exactly with the declivity of the valley by which the district is drained. Thus, near Watford and in the vicinity of the river Colne, all the wells require to be sunk to the level of the Colne before the supply of water is obtained; but as we proceed up the valley towards Boxmoor, Berkhampstead, and Tring, water is procured at levels corresponding strikingly with the inclination of the valley, far above the levels of the water in the wells at Watford.

The Tring cutting on the London and Birmingham Railway presents another forcible example of the constant and rapid absorption of water by the chalk. In the execution of that cutting a very large quantity of water was encountered, notwithstanding the situation was on the summit of the chalk ridge, forming the actual brim of the basin, where it could not be supplied with any water but such as fell upon the immediate neighbourhood, yet it yielded upwards of one million gallons per day, and continues to yield an extraordinary quantity up to this hour, without any sensible diminution.

This is surely incontrovertible evidence that the chalk absorbs water with the utmost facility, and as a consequence, when the levels are suitable, readily yields it up again. It may not be uninteresting to add, that previously to this work being commenced, attempts were made to sink wells to test the material from the surface of the land to the intended depth of the cutting; but so freely did the water flow from the chalk, that it was found impossible to sink several of them by ordinary means to the depth of 60 ft. Similar results have followed all experiments of this kind which I have witnessed, and those who are best acquainted with the sinking of wells throughout districts occupied by the chalk formation, concur in the opinion that it should be regarded as an *enormous mass of rock saturated with water, which it yields with the utmost rapidity, by the action of a very small hydrostatic pressure.*

I might here enter into a minute detail of the levels of the wells sunk in the districts occupied by chalk, which have come under my observation, were I disposed to extend this report to an unusual length; but I believe it will be more satisfactory to the committee that I should allude to the results which have been laid before me by the gentlemen who were deputed by me to examine waterworks, which are known to derive their supply entirely from such wells; with this impression, therefore, I transcribe the following extracts from the reports which have been placed before me:—

Winchester.—This town is at present supplied by wells. There is a well that has lately been sunk on the hill, near the barracks, entirely through chalk, to the depth of 170 ft.; near the bottom there are fissures, out of which the water rushes with considerable violence; the water rises about 10 ft., and after pumping for seven hours successively, it is reduced 2 ft., but immediately the pumps stop working it rises again to the same height in 15 minutes.

The water is raised by the aid of an 8-horse engine working a 6-inch pump, 2 ft. stroke, and from 18 to 22 strokes per minute; at 18 strokes per minute the pump lifts 44 gallons, or 31,680 gallons per 12 hours.

At the railway station there is another well sunk in the chalk, to the depth of 80 ft.; at Christmas time there was about 4 ft. of water, and in April about 12 to 14 ft. In October, a month when the springs are generally low, the engine was kept constantly at work, day and night, for 4 or 5 weeks, and could not lower the water beyond 2 ft. from the bottom. In July, last year, after working the pump for an hour and a half, the water could not be lowered more 18 inches. The quantity the pump lifts is the same as described above. The engineer never knew a deficiency.

Through the town of Winchester there is a very fine stream of water, which rises from the chalk hills.

I was informed, at Winchester, that at Sir William Heathcote's seat at Merdon Farm there is a well in the chalk, 331 ft. deep; the water appears to pass across it like a river, with a rapid current.

Sir Thomas Baring, at his seat at Stratton Park, has sunk a well in the chalk, and is now having a steam engine erected for lifting the water to supply his estate and mansion.

Arundel.—There is a well at the bottom of the town, which supplies nearly the whole of the inhabitants of that portion. It is stated to be only 20 ft. deep, sunk in the chalk; a deficiency has never been known.

The upper part of the town and the castle are supplied from a spring, which rises from the chalk in the valley, on the south-west side of the town, where there is always an abundance.

Brighton.—The whole of this town is supplied with water obtained from the chalk, either by wells or from the water-works. The water-works are situated about a mile from the town, on the Lewes road, adjoining the barracks. The surface of the ground at the well is 64 ft. above high water mark. A well has been sunk to the depth of 97 ft.; at 16 ft. above the bottom there are four adits driven in from the sides of the well, to the extent of 46 ft. each, and about 6 ft. square; they are driven north, south, east, and west; the water flows into these adits from fissures in the chalk, in very considerable quantities, and appeared to flow towards the sea.

The water rises to different heights at various periods of the year; it has been as low as 58 ft. 6 in. from the surface, or 38 ft. 6 in. of water, and as high as within 8 ft. 10 in. of the surface. In the present month of April, when I viewed the works, before the engine commenced working, it stood at 31 ft. below the surface, or 66 ft. of water, and after the pumps had been working 12 hours, the water was lowered 2 ft. 9 in.; it will regain that quantity in a very short time after the pumps have ceased working.

The water is lifted by an engine of 20-horse power, working three pumps 8¼ in. diameter, and three pumps 8½ in. diameter, both 18-inch stroke, and 15 strokes per minute, lifting together 231,840 gallons per 12 hours, the time the engine works daily, Sundays excepted.

Previously to the Company being formed, there was a strong opposition in the town, and a cry that "all the wells would be dried up," but since the works have been in operation, there has not been a single complaint. The only well that was effected was one close to the works in the barrack yard: this well has been lowered a few feet, and no complaints of want of water have arisen since then.

The supply at present is to about an eighth part of the town, besides for watering the streets, and it is daily increasing. The quantity is amply sufficient for the whole town. When the springs were low in June, 1840, the six pumps were kept working day and night, for eight days, when the water could not be lowered more than 12 ft.

The pumps are fixed in the well in such a manner that either set can be raised or lowered, according to the height of the water in the well. There are two rising mains 9 in. diameter, (one to each set of pumps,) and an air-vessel, 4 ft. diameter, 6 ft. high; the delivery-pipe from the air-vessel is 12 in. diameter; near the exit it is furnished with an air-valve and a steelyard lever, loaded with about 80 lb. The water is conveyed through a 12-inch main, about a mile in length, to the reservoir, the bottom of which is 113 ft. above the top of the well, and the surface 120 ft. The water is conveyed from the reservoir by a 10-inch main to supply the eastern part of the town, and a 12-inch main, to the old Stein, then 10 in.; there are branch mains, from 5 to 10 in. diameter; the service-pipes vary from 2 to 5 in. diameter.

Dover.—This town is entirely supplied with water from wells sunk in the chalk, and from the water-works at the lower level of the towns in Mr. Walker's yard, where there is a well sunk in the chalk below the cliff; the surface is 10 ft. above high water mark, the depth is 33 ft. 6 in., and the diameter 12 to 13 ft.; it is a tidal well; when high water, there is about 10 ft. of water, and at low water, 3 ft. The water is lifted by the aid of a 25-horse engine working two pumps, 8 and 9 in. diameter, 3 ft. 6 in., and 3 ft. stroke, and 18 to 20 strokes per minute; at the rate of 20 strokes they lift 317 gallons per minute, or 228,240 gallons in 12 hours; the water is lifted 160 ft. to the top of a tank.

This well supplies about 50,000 gallons per diem. There is another supply obtained at the gas-works, lifted by the aid of a two-horse engine.

Deal and Walmer.—Water-works have been lately erected about a mile to the west of Deal, which obtain their supply from a well 120 ft. deep and 6 ft. diameter, the surface being 90 ft. above low water mark; there is 16 ft.

of water standing above the bottom; there are two wells, one 110 ft. deep and the other 120 ft., which are connected together by a tunnel driven from within 4 or 5 ft. of the bottom of the deeper well to the bottom of the other; from this tunnel a very copious supply is obtained at all times; after 10 hours' successive pumping the water is lowered 10 ft., and regains it after the pumps have ceased working in three hours.

The water is raised by the aid of an 8-horse engine, working two 8-inch pumps, 22-inch stroke, and 20 strokes per minute, lifting 160 gallons per minute, or 115,200 gallons in 12 hours. There is a well within 120 yards of the above wells belonging to the mill, 90 ft. deep, which has never been effected by the pumping at the above works.

RAMSGATE.—This town is entirely supplied by wells in the chalk, and water-works; principally, however, from the latter, which obtain their supply from a well sunk in the chalk, the surface of which is 177 ft. above high water mark; the depth is 183 ft., of an oval shape, 9 and 6 ft. diameter; the lower 25 ft. is enlarged to 25 ft. diameter, from the sides of which there are two tunnels, one 42 ft. long, and the other 25 ft., which supply an abundance of water, issuing from fissures in the chalk; there is generally 26 ft. of water, which is reduced to 16 ft. after the engines have been working 12 hours. The water is raised by means of a 12-horse engine, working two 14-inch pumps in two lifts, 24-inch stroke, and 16 per minute, which lift 224 gallons per miuute, or 153,720 gallons per 12 hours. There is also a smaller engine of 6-horse power, working two 9-inch pumps occasionally. The large engines are worked three days per week. The water-works supply about 700 houses, two or three breweries, malthouses, and shipping; a deficiency has never been known. There is a well belonging to a cottage within 100 yards of the above well, and 160 ft. deep, which has never been affected since the works have been erected, nor has there been a single complaint in the town.

The water is raised into an open reservoir near the engine-house, and conveyed by a 9-inch main the distance of 1¼ miles to the town.

CANTERBURY.—This city is principally supplied from wells sunk in the chalk.

GRAVESEND.—This town is supplied by a well sunk in the chalk, and also by water-works near Windmill Hill, where there is a well sunk entirely in the chalk, 138 ft. deep; at the bottom there is a tunnel from which the springs issue; the water is raised by the aid of an 8-horse engine, working two 12-inch pumps, 24-inch stroke, and 10 strokes per minute, which is 195 gallons per minute, or 140,000 gallons per 12 hours.

About four years ago an action was brought against the Water-works Company by the proprietor of a well in the vicinity of the works, for a supposed injury. The proprietor alleged that his well was affected when the engine was working, and shortened his supply. The case was referred to a barrister, who examined several engineers and others, whose evidence was so contradictory that he made a personal examination on the spot: after sealing down the cover of the well, the engines were kept working, under his directions for a certain length of time; and after the time was concluded, the well was again examined. Subsequently the barrister decided in favour of the company. I have not yet been able to obtain the precise particulars of the inquiry, but the above statement shows that the barrister did not consider that the well was affected.

Nearly 40 years since a speculation was commenced, to make a tunnel under the Thames at Gravesend. A shaft was dug, and a powerful steam engine erected, a little to the westward of the gas-works, under the superintendence of Mr. Dodd, the engineer. After an expenditure of several thousand pounds, it was found impossible to get rid of the water. The stratum was chalk. The water was perfectly fresh, although the river water in this part of the Thames is brackish.

ST. ALBANS.—This town is supplied by wells sunk in the chalk, and by water-works which obtain their supply from a well sunk in the chalk to the depth of 165 ft. The water rises to the height of 19 ft., and is raised by the aid of a steam engine of 8-horse power, working a 5½-inch double acting pump, 24-inch stroke, and 20 strokes per miunte, which lifts 82 gallons per minute, or 59,040 gallons per 12 hours. After pumping that period, the water is reduced to 9 ft. In the immediate neighbourhood of the works there are several wells, one within 20 ft., none of which were ever affected by the pumping of the above engine.

The above extracts from reports made by gentlemen who visited the various places, must, I am persuaded, go far to satisfy the most sceptical that the chalk formation is everywhere abundantly charged with water; they in fact demonstrate, that many very important towns are at this moment actually deriving their supply from that rock which Mr. Webster denies to be a water-bearing stratum; and whilst reflecting on this fact, it should not be forgotten that, in all the instances just alluded to, no resources beyond small wells and a few short drifts were required to afford supplies which should not be regarded as inconsiderable, more especially when connected with a statement that water cannot be obtained abundantly from the chalk formation.

I cannot, however, content myself with extracts from reports made by parties who may be supposed to be prejudiced in favour of the project with which they are connected. I must, therefore, insert a few passages from "Conybeare and Phillip's Geology,"—a work, whether we regard it as descriptive of the state of geological science at the period of its publication, or as a record of an extraordinary mass of practical facts intimately connected with the science, alike deserving admiration.

In speaking of the chalk formation, they say—

The lower beds of the chalk formation and every fissure, are, with few exceptions, completely filled with water. All the rain and snow which fall upon chalk percolate downwards to the base, where the water is stopped by a sub-soil of blue clay, and that occasions it to accumulate in the chalk, until it rises to such a height as doth enable it to flow over the surface of the adjoining land."

"In this manner are formed the springs and rivulets which issue near the foot of every chalk hill."

These are the observations and conclusions acquiesced in by parties who were influenced solely by the investigation of truth. They were not swayed by any particular bias; their opinion cannot be supposed to be affected by one motive beyond those which science demands.

Having, therefore, I trust, satisfactorily proved that the chalk abounds with water, it will naturally be expected that I should meet the question of *quantity;* for upon this some of my anonymous assailants establish their case, not, I must confess, without a show of probability, provided we admit that what has not hitherto been done is impracticable.

I grant, at once, that the quantity of water—viz., 8,000,000 gallons per diem, which it is now proposed to raise from a shaft or shafts sunk in the chalk, has no precise precedent; but, surely, this admission is no argument against the possibility; on the contrary, I hold that the fair deduction from the above record of facts is, that *this* or a *much larger supply may be obtained from the chalk*, from prosecuting the sinking of shafts much deeper than has hitherto been attempted, together with the extension of horizontal driftways from the bottom of the shafts.

On mentioning the horizontal driftways, it is perhaps unnecessary to reply specifically to Mr. Webster's observations on this expedient for procuring an increased supply; for when he speaks of "groping" in the dark for water, it is obvious that he is unacquainted both with mining and with the precise nature of the construction of the chalk rock, and particularly in reference to the character of the fissures which intersect its mass in every possible direction—sometimes, it is true, more in one direction than another—easily, however, determinable by observation.

Mr. Webster playfully opens his remarks by observing that "Many are old in years, yet young in geology." This assertion I will not attempt to dispute, but state another, which I hope Mr. Webster will as readily concede—viz., "Some are old in *years*, yet young in *mining*." When Mr. Webster has spent as much of his time underground as I have done, and not till then, will he understand the exact truth of this remark. I will not permit myself, however, in this place to make any remark in disparagement of Mr. Webster, as I am convinced any observation of a personal nature never, in a question of this sort, can be substituted with propriety, for sound arguments or fair deduction.

With respect to the extent of supply, therefore, I would at once refer to every mining district in this or any other country. Can we look at Cornwall (when considering the matter in reference to the supply of water from chalk, as a rock abounding with water,) without concluding at once that increasing the depth of our shafts beyond those examples already quoted would be attended by a prodigious augmentation in the flow of water to the well. The extension of the under-ground workings of a mine, and the concomitant increase in the supply of water, are equally calculated to bring to the mind the overpowering conviction, that similar results would inevitably follow the adoption of deeper shafts and a more extended system of drifts than have hitherto been attempted in the chalk. To minds unhabituated to such consideration, these general allusions to mines may not present the same conviction; but to the experienced miner, I am persuaded the conclusions I have drawn from the facts (exhibited by the wells sunk in the chalk near Watford and elsewhere) will appear as necessary consequences.

It was my wish, in this Report, to have cited some well-authenticated particulars relative to the quantity of water raised from mines in different parts of this country, believing that they would have borne out my views in the strongest possible way; but on pursuing my inquiries upon this subject, I found that I could only arrive at general results, for it unfortunately happens that accurate records, in a shape calculated to be of value, are not kept in the various mining districts. In Cornwall, however, this remark does not apply so forcibly, for a precise record of the performances of all the pumping engines employed in draining the mines is published in "Lean's Monthly Reports."

From these Reports it is ascertained that upwards of thirty millions of gallons of water are daily raised from great depths to the surface, and from the consolidated and united mines alone, the daily quantity exceeds 5½ millions of gallons.

There can be no doubt that, were similar records kept of the quantity of water raised to the surface in other mining districts of this country, that results equally if not more striking would be exhibited, nor should we, in the comparison, neglect to notice the fact that, unlike the chalk, the primary strata of Cornwall in which the mines are sunk possess but limited channels for the free communication of the water.

These allusions to the mining districts may be deemed, perhaps, by some, as altogether irrelevant and inapplicable to the point under consideration, since the shafts are scattered over an extensive space of country. This is certainly true when we speak of Cornwall; but the objection is to a certain degree obviated by specific allusion to the consolidated mines, and I can fortunately advert to another case, respecting the quantity of water which may be obtained from one or two shafts—an instance which, I think, must be considered unequivocal.

In the county of Durham two shafts within a few yards of one another

in process of being sunk for the purpose of a coal-pit. They have
ered a stratum of sand lying between the magnesian limestone and
formation, abounding with water to an extraordinary degree. For
onths past, and up to the present moment, more than 10,000 gallons
ute, or 14,000,000 per 24 hours, have been pumped from the stratum
crossing these two shafts.

then, surely we have an instance which proves the practicability of
g, within a small space, a much greater quantity of water than is
or, or calculated upon, from the proposed shafts in the chalk.

probable that some may be found to urge that, even here, the cases
absolutely parallel, the water in the one instance being drawn from
d in the other from chalk; but I would ask when we connect this
quantity with those already mentioned as actually existing in the
or example, at Brighton,) can any reasonable doubt be entertained
pply, up to the amount of 10,000 gallons per minute, or *more*, may
obtained from the chalk by the adoption of the means I have
d?

g, I believe without prejudice, most carefully weighed these and all
cts which have come before me relative to this matter, I have only
hat I am perfectly convinced of the feasibility of the proposed plan,
regards quantity.

now I beg to relinquish this part of the subject, and proceed to
which will, doubtless, form one of the chief features in the oppo-
hich you will encounter in laying your project before Parliament—I
the question whether such a quantity of water as you contemplate
to the metropolis can be drawn from the chalk without injuriously
local interests?

part of my former Report bearing upon this point was vehemently
question by the Rev. Mr. Clutterbuck, of Watford; and as he and
ives possess property in the neighbourhood of that place, I con-
t my duty to recommend the Committee to allow Mr. Clutterbuck
st any experiments which he conceived were calculated to decide
the views I entertained were correct or incorrect.

is purpose, he suggested that the steam-engines at the experimental
ear Watford should be kept at work without intermission for three
nights; that previously to the pumping being commenced the levels
ater standing in all the adjoining wells should be accurately ascer-
that these levels should at proper intervals be again measured, for
ose of detecting any change which might take place during the
of pumping.

ily acquiesced in every suggestion which I thought calculated to allay
prehensions Mr. Clutterbuck and others needlessly entertained.
gly, on the 3rd day of March, 1841, the necessary preliminary
nents having been made, the engines were set to work, and, at the
the experiment, not one of the levels of the different wells was
corroborate the objections of Mr. Clutterbuck; so far from it,
no perceptible difference in any one of them.

nly reasonable to expect that an experiment of this kind, undertaken
for Mr. Clutterbuck's satisfaction, and, as it were, under his own
, would have enabled him to remove from his mind any impressions
injurious consequences which he had anticipated would result from
blishment of water-works in the immediate neighbourhood of his
; on the contrary, he adheres to his preconceived opinions, instead
ing the most simple, obvious, and only rational conclusions from the
eloped by the experiment made at his own suggestion.

dresses a letter to Sir John Sebright, in which he studiously avoids
l of the experiment made at his express wish, and during which
arties were associated with him in taking the measurements, and
rward other measurements, and observations made by himself *alone*,
prior period, during the sinking of the shafts, when no regularity
n working the pumps. He never even alludes to the wells in the
Watford, some of which he measured with myself; he does not
at those levels were taken with a confident anticipation on his part,
would be instantly lowered when the pumping commenced. He
mention of the disappointment on finding, after three days' inces-
ping, that those levels were in no degree affected; he makes no allusion
ne of these circumstances or results that so completely negatived his
positions, and which would have carried conviction home to the
any unbiassed inquirer after truth; but he proceeds disingenuously
various levels of wells, taken by him at a distance of several miles
tford, where it was quite impossible the influence of pumping could
yet all the variation of level in the distant wells he deliberately
to the pumping, without making the slightest effort to reconcile
epancies which would have been apparent, had he candidly recorded
ts of the experiments to which I have already previously alluded.
in fact, that the wells in the immediate vicinity would not tally with
ns, he calls in the aid of distant wells, where the levels, according
n showing, were so capricious that anomalies constantly presented
es, and in the end he adopted a theory at variance with all hydro-
laws. To discuss it would really be a waste of time, and I think I
justified in treating it thus summarily, by stating that it follows
theory, that pumping at any point in the chalk is not so likely to
neighbouring as the distant wells; and so distinctly is this the
of his theory, that he gives a diagram where the level of the water
alk is shown to be influenced to a far greater extent at fifteen miles
ne mile distant. Previously to the experiment being made at Mr. Clutterbuck's request, I fully explained to him the circumstances which had led me to entertain views so diametrically opposed to his own; I explained, in the most particular manner, that those opinions were forced upon me by a long series of observations which could not be called in question; still he never refers to the facts which I communicated to him, but finishes his letter with an exposition of views totally irreconcilable with them. The series of observations I have just mentioned were brought before me during the execution of the Kilsby Tunnel, on the London and Birmingham Railway, where an extensive bed of quicksand was met with in the process of tunnelling. Before any progress could be made, it was necessary to drain the sand of water, and for this purpose several shafts were sunk and steam engines erected on the line of tunnel. As the pumping progressed, the most careful measurements were taken of the level at which the water stood in the various shafts and boreholes; and I was soon much surprised to find how slightly the depression of the water level in the one shaft influenced that of the other, notwithstanding a free communication existed between them through the medium of the sand, which was very coarse and open. It then occurred to me that the resistance that the water encountered, in its passage through the sand to the pumps, would be accurately measured by the angle or inclination which the surface of the water assumed towards the pumps, and that it would be unnecessary to draw the whole of the water off from the quicksand, but to persevere in pumping only in the precise level of the tunnel, allowing the surface of the water flowing through the sand to assume that inclination which was due to its resistance.

If this view were correct, it was evident that no extent of pumping whatever would have effected the complete drainage of the bed of sand. To test it, therefore, boreholes were put down at about 200 yards from the line of tunnel, when it was clear that, notwithstanding pumping had been going on incessantly for twelve months, and for the latter six months of this period at the rate of 1800 gallons per minute, the level of the water in the sand, at a distance not exceeding 200 yards, had been scarcely reduced.

The simple result, therefore, of all the pumping was merely to establish and maintain a channel of comparatively dry sand in the immediate line of the intended tunnel, leaving the water heaped up on each side by the resistance which the sand offered to its descent to that line on which the pumps and shafts were situated.

Observations of this description were continued for upwards of two years, and it is upon them that I rest my views respecting the drainage of the chalk, or any other porous stratum or mass, by means of pumps concentrated at a focus; indeed, when once suggested, it seems so self-evident that we may with considerable confidence predict the results of any pumping operations, under such circumstances as are found to exist in sand, chalk, or any rock or material, presenting resistance to the free motion of the liquid flowing through it. This resistance is unquestionably represented by the angle of inclination which the surface of the water assumes, and this, again, is no doubt much influenced by the size of the fragments of which the same may consist, thus giving rise to a variety of modifications in the slope of water, in different directions, from the focus of pumping.

If the above views be correct, and of which, supported as they are by indisputable facts, there can be no admission of a doubt, it follows that the result of pumping at a deep shaft, in chalk or other similar porous material, would be the drainage of a portion of the district, represented by an inverted cone, the point being at the bottom of the shaft; the upper surface, or what is generally designated the base of the cone, occupying an area depending on the inclination which the fluid assumed in passing through such porous mass. This inclination must vary with the character of the material, but in no chalk that I have ever met with can it be inconsiderable; consequently, from no extent of pumping at any one point in a formation like chalk, can the influence be apparent at any great distance.

Before I commenced the above remarks, it was my intention to have extended them into greater detail, but I found that adducing abstract calculations would tend rather to obscure than to elucidate that which is really clear and simple. I have, therefore, contented myself with such a statement as will convey, I trust distinctly, my views, and the reasons upon which they are based, and I am not without hope that the following facts are established —viz.:—

1. That the chalk is the "great water-bearing stratum" underlying the London clay, and from which all the Artesian wells, directly or indirectly, draw their supplies.
2. That below the level of its natural drainage of the country it is charged with an enormous quantity of water, which may be obtained with extraordinary facility by pumping.
3. That the quantity obtainable from shafts is amply sufficient to meet the object contemplated by the Company.

These facts established, it is scarcely possible to believe that any who are interested in the supply of the metropolis with pure water will hesitate in assisting you in carrying out your project, and I cannot conclude without expressing an ardent wish that the subject may be treated by *all parties* in a liberal and impartial spirit; and I am persuaded that this new source of supply of water will soon be made available for the most important capital in the world.

ROBERT STEPHENSON.

EXPERIMENTS ON FOUR WHEELED ENGINES.

An experiment has recently been made on the London and Birmingham Railway, to show the safety of four wheeled engines when the fore-axle is broken; for this purpose the fore-axle of a four wheeled engine was cut nearly through, and in this state, was sent from the station towards Roade; the fore-axle broke in two as intended, at the point where it had been divided, but the occurrence had no apparent effect on the movement of the engine, which continued its course till it reached Roade, when it was crossed from the down to the up line, and returned in safety to Wolverton. On the following day, the engine in precisely the same state started from Wolverton, with six wagons of wheels and axles—making a gross load of thirty-two tons, exclusive of engine and tender. With this load the engine attained a speed of twenty-five miles per hour, and arrived safely at the Watford Station, distant thirty-four miles. Soon after leaving Watford, and when it was again running at a speed of twenty-five miles per hour, one of the front wheels slipped off the rails, and the engine was delayed seven minutes until it was replaced. The engine again proceeded towards London, but at about two miles beyond the Harrow Station, where the line is on transverse sleepers, the wheels once more slipped off the rails, and the engine, in that state, ran upwards of 200 yards before it was stopped. In twenty minutes it was again lifted on to the rails, and started to Camden Town, where it arrived in safety before five o'clock.

[The experiment is reported to be "highly satisfactory." For our own part we cannot see what there is to make it so "*highly satisfactory;*" we view the experiment in a very different light; what more serious evil can there be than an engine running off the rails as in the above case? Imagine an engine twice off the rails within the distance of ten miles! Suppose a similar accident had occurred with any other engine and train, would the tools and the men have been ready to replace the engine upon the rails within ten or twenty minutes after the accident had happened? and would the same precautions have been taken and the same look-out for the avoidance of accident? Let us hear of no more such mad-brainen, hair-breadth experiments; this one is quite enough.]

THE VARIATION OF THE COMPASS.

Observations made at the Royal Observatory, Greenwich,
G. B. Airy, Astronomer Royal.

Mean Magnetic	Variation.	Dip at 9 A.M.	Dip at 3 P.M.
	° ′ ″	° ′	° ′
1842. March	23 10 39	68 27½	68 32
April	23 11 0	68 40	68 35

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

March 15.—The President in the Chair.

"*Description of the Iron Skew Bridge across the Regent's Canal, on the Eastern Counties Railway.*" By Edward Dobson, Assoc. Inst. C.E.

This bridge is built with a direct span of 54 ft., at an angle of 79° with the centre line of the canal. The level of the rails is 14 ft. 6 in. above the water, and it is constructed to have a water-way of 44 ft., with a clear head-way of 10 ft. above the towing-path.

The dimensions of the several parts of the bridge and the mode of putting them together, with the masonry and the cost of the construction, are described in detail, and illustrated by an elaborate working drawing.

As an appendix to this paper a description is given of a bridge over the same canal, on the line of the London and Birmingham Railway, on account of the similarity of its construction. The span of this latter bridge is 50 ft., but being made for two double lines of rails, it was thought expedient to have three main ribs instead of two, as in the former. The details of construction of this bridge are also given, with a drawing of one of the main ribs and its tie-bar.

"*Remarks on the Ravages of the Worm (Teredo Navalis) in Timber.*" By Robert Davison, M. Inst. C.E.

This communication describes the ravages committed by the "Teredo Navalis" upon the fir piles of the foundations of the old bridge at Teignmouth, five arches of which, after having been built only 12 years, fell suddenly; the construction of a new bridge thus became necessary, and it is now in progress under the direction of Messrs. Walker and Burges. The worm is described as entering the wood through a hole not larger than a pin, and perforating the timber in all directions, but chiefly in the direction of the fibre, at the same time increasing the size of the holes even sometimes to an inch diameter; a few of the worms had been found of the extraordinary length of 3 ft. They confine their operations between low-water mark and the bottom of the river, showing that they cannot exist out of water.

A specimen of part of a log picked up off Jersey was as much perforated, but in a different manner, the worms having penetrated the wood indiscriminately all over the surface; in some cases leaving in the holes a coat resembling the tail of a lobster about 3 in. in length, which showed that the ravages had been committed by the "Lymnoria Terebrans."

The paper was also accompanied by a specimen of wood sheathing charged with nails, from the bottom of a vessel believed to be about 100 years old, together with some of the worms ("Teredo Navalis"), for the purpose of showing the peculiar shape of the head—resembling a pair of forceps, with which they cut away the wood.

"*Description of the Roof of Messrs. Simpson and Co's Factory.*" By John Boustead, Grad. Inst. C.E.

The truss of this roof is double, consisting of two frames of Memel timber. The principals are fitted into cast iron shoes resting on the walls, with projections let into the wall plates; they taper towards the ridge, and there abut against a cast iron ring-piece, through which a wrought iron bolt 1¼ in. diameter passes, and answers the purpose of a king-post in supporting the collar-beam. To the under side of this beam is attached a heel and eye-plate, to either end of which are linked bolts passing between the principals, and secured by nuts at the backs of the shoes, thus forming efficient ties to resist the thrust of the principal rafters.

The slate-boards are supported by five purlins 4 ft. apart, and abut against a ridge-piece resting on the kings.

The span of the roof is 34 ft. 3 in. The pitch is about 3 to 1, and the principals are placed 9 ft. apart.

The scantlings of the principal timbers are:—Principals 9½ by 2½ in. tapering to 6½ by 2½ in.; collar-beam 7 by 3½ in.; purlins 6 by 4 in.; wall-plates 6 by 4 in.; slate-boards 1 in. thick; ridge-piece 10 by 2 in.

The principals were sawn out by a template, so as to insure the given taper and the accuracy of the angles of the ends; they were then laid in a horizontal position placed at the required angle, and the collar-beam inserted ½ in. deep into each principal, and secured by bolts ⅞ in. diameter; the mode of raising the roof is then described.

Some of the advantages of roofs of this construction are stated to be, economy in materials and workmanship, with lightness and simplicity, and that all sagging of the timbers may be rectified by screwing up the nuts of the kings and shoes.

The truss is recommended for buildings where lofty apartments or coved ceilings are required, and also for its presenting so few points for the suspension of heavy weights that may subject the timbers to strains for which no provision has been made.

From the examinations that have been made, this roof seems to answer satisfactorily; it has been erected three years and a half, and has sustained heavy falls of snow, but the ridge and rafters have preserved their lines perfectly, and the walls show no signs of having been subjected to undue pressure. The design of the roof is simple, its appearance light, and it may be considered an interesting specimen of the art of simple carpentry assisted by iron-work.

A drawing of the truss accompanied the paper.

ACADEMY OF SCIENCES.

April 4.—M. Siguer read a paper *On the means of preventing the explosion of boilers in steam vessels*, or of confining the effects of such explosions, when they do occur, within very circumscribed limits. He recommends, as a general principle, that the boilers should be composed of many distinct parts (tubes), so that in the event of the rupture of any one portion, there may be no injury beyond the engine-room, and that the metal of which they are composed should be thin, in order that it may not be deprived of its tenacity in the process of manufacture; and he insists upon strict attention being paid to their shape, which should, he says, be spherical, cylindrical, or conical, as being best calculated to offer an equal resistance to the explosive power.

M. Arago communicated the result of some experiments made with the view of solving the long-disputed question as to whether the *transmission of light* is more or less rapid, according to the density of the medium through which it passes, and reported his experiments before the Academy in proof that the transmission is not equally rapid.

M. Dupasquier read a paper *On the use of iron as a test in Marsh's apparatus for the detection of arsenic.* M. Dupasquier stated unequivocally, that by the use of a preparation of iron, such as had been resorted to at times by chemists intrusted with the task of testing the presence of arsenic, stains apparently arsenical, but which are not so, may be produced.

April 11.—A paper was read by M. Domeiko, *On the silver mines in Chili*, and the mode of working them. The mines extend from the north to the south, parallel with the coast, to a distance of 150 leagues from the environs of St. Yago to the other side of Copaipo. The silver mines of Acqueros, which are the special subject of the paper communicated to the Academy, were discovered in 1825 by a muleteer, whilst collecting wood on the mountain. He found by chance several small blocks of native silver, and, having mentioned his discovery to his acquaintances, they proceeded to the spot, and collected immediately silver to the value of 10,000 dollars. Soon afterwards the vein itself was discovered, and its richness was found to equal all that had been anticipated. From that period up to 1840, the date of the last returns, this vein has yielded about 30,000 marcs of silver annually.

A paper was read *On the Daguerreotype improvements of M. Bisson.* M. Bisson, by a galvanic process, covers the plate with a slight coating of silver, much more even and perfect than the surface of the ordinary silvered plate, and the object was, consequently, represented with greater fidelity and boldness. Another improvement of M. Bisson's is, in giving, by the action of the galvanic pile, a slight gold tint to the drawing, which takes away its unpleasant looking-glass appearance, and causes the objects to stand forth almost as clearly and vigorously as in drawings produced by hand.

April 18.—A paper was read by M. Regnault, *On the dilating powers of gases, and on the relative powers of air and mercurial thermometers.*

A specimen of a reddish sediment, deposited by a shower of rain at Amphissa, in Greece, on the night of the 24th ult., and forwarded by M. Bouros, with a paper on the subject, was examined by the Academy. The last mail from Smyrna brought an account of a similar fall of rain at about the same time. One of the journals of that place, alluding to this phenomenon, states, that the sediment resembled the sand of the desert, and supposes it to have been taken up by a whirlwind, and, combining in the clouds with water, to have been held in suspension until it had travelled to a distance of nearly 1,000 miles to Smyrna. The wind, adds the *Smyrna Journal*, was blowing fresh from the southward at the time, bringing heavy clouds, accompanied by a peculiarly hazy atmosphere, observable only in long continued siroccos.

May 3.—A paper was read from M. Reville, of Havre, *On the use of cotton sails for ships*, as more economical than those made from flax, and being at the same time equally serviceable. Certificates from various persons who have made use of cotton sails, and specimens of their old and new were laid before the Academy.

From Messrs. Hempel and Hamann, *On a new Compass, of their invention, for measuring ellipses.* The report of Col. Puissant and M. Sturm on this invention, which was read to the Academy, states it to be superior to any instrument for the same purpose hitherto known; consequently, the Academy decided on expressing publicly its approbation of the invention.

From M. Jobard, of Brussels, on some experiments which he proposes to make, with a view of ascertaining the best means of *preventing the explosion of steam boilers.* The principal experiment proposed by M. Jobard is, such a construction of the boiler as will permit, when the mixture of explosive gases has been formed, the introduction of a stream of atmospheric air, so as to render them inexplosive.

From M. de Castelnau, *On some geological revolutions in the central parts of North America.* The period to which M. de Castelnau directs the attention of the Academy is that corresponding with the geological revolution to which the bordering portions of Canada and the United States owe their present configuration, viz. that which formed the great Lake of Canada, extending from east to west, with the exception of Lake Michigan, the direction of which is from the north to the south, with a slight deviation towards the west. At the south of the southern point of this lake, there extend toward the Ohio on the one side, and the Mississippi on the other, vast prairies, entirely formed of deep alluvial soil covering an old calcareous bed. Every thing indicates, says M. de Castelnau, that this region was formerly the basin of a lake of much greater extent than those which now exist in this part of the world, and, on approaching the Mississippi, the proofs of this phenomenon become more evident. He considers it certain, that at a remote period there was some obstruction to the course of the Mississippi, which produced a stagnation of its waters, and raised them to an elevation of 40 metres; for wherever the rocks present an abrupt front towards the river, they offer a series of parallel lines, inclining slightly towards the north. The geological formation of the land in the vicinity of Lake Huron, presents the character of a vast Silurian formation. According to M. de Castelnau, Lake Superior formerly discharged itself into Lake Michigan, which had its termination in an immense basin, to which he gives the name of Lake Silurian, and which probably discharged the excess of its contents into the Mexican Sea; but a revolution of nature checked the passage of the waters to the extremity of Lake Michigan, and produced at Lake Silurian the rising ground known as the Illinois, which must have been of greater extent than it is now, and it is not impossible, that with its progressive depression, the waters will at some distant period resume their former course.

May 9.—At a special meeting M. Cordier communicated various details relating to the *horrible accident on the Versailles railroad*, extracted from an official report addressed to the Minister of the Interior by Messrs. Combes and De Senarmont, the engineers of Mines, charged with the inspection of rail-roads. In addition to the facts already known, it states that the foremost locomotive was a small one, with four wheels, and the other one of large dimensions with six wheels, made by Sharp and Roberts. The boilers of both are at present without the slightest injury. According to the testimony of the Commissary of Police of Meudon, one of the carriages was altogether consumed in ten minutes. The report contains the following summary as to the cause of the calamity. The accident originated in a fatal concurrence of circumstances, which were all gross faults, easy to have been foreseen, and still more easily to have been avoided. The first cause of the accident was the employment of a locomotive with four wheels. It is essential that every carriage intended for service on a railroad should rest on six wheels at least, in order that if one of the axles should break, the carriage should rest on supporters, and continue its course. The second fault consisted in the employment of two locomotives for a single train. The consequences of this arrangement are self-evident. A third circumstance was, the precaution taken to lock the door of the wagons; so that in such a case as that which occurred, all escape was prevented, and the travellers were condemned to suffer all the consequences of the first accident. Another cause which had much influence on the catastrophe, was the neglect to isolate the train from the locomotive, so as to prevent the shock occasioned by the sudden check to the speed with which they were proceeding. It is worthy of remark, that if all those causes had not existed together, and if only a single precaution had been taken, the accident would not have happened. If the first engine had been furnished with six wheels when its axle broke, it would not have lost its equilibrium. If a second locomotive had not been employed, the only consequence of the accident would have been a shock; and, even admitting that the two first causes of the accident existed, had the doors of the wagons not been locked, a number of the passengers might have escaped the flames; and the interposition of the elastic system would have saved the train even if no other precaution had been observed. The Academy listened to the account in mournful silence. Several members afterwards made remarks on the inconvenience of using locomotives with four wheels; M. Elie de Beaumont particularly protested against immense trains being drawn by several locomotives, the danger increasing in proportion to the number of machines employed. The custom of locking up the passengers was also much spoken against. Towards the close of the sitting, a rumour having spread in the Academy that Admiral Dumont d'Urville was amongst the number of the dead, or at least that he had not been found after the accident, it being certain that he had entered one of the foremost wagons, M. Arago proposed that two members should be appointed to make inquiries respecting him; and if they found him among the wounded, to testify to him all the interest that the Academy took in his fate.

A report by M. Seguin, was read, of a series of experiments performed by order of the Academy *on the cuirass made of hemp*, the invention of M. Papadapoulo. The report states, that the balls of cavalry pistols, fired at a distance of from three to five paces, only penetrate to a depth of about the third of an inch: consequently, the report is favourable to the inventor; but a discussion having arisen on some points not alluded to in the report, the decision of the Academy, as to the value and importance of the invention, stands over until the points under discussion shall have been treated upon by the reporter.

MISCELLANEA.

The Monster Steam Ship.—This vessel, which is nearly ready to be launched, is built by three or four spirited individuals on their own speculation in the small town of Derry, Ireland, where a few months previously it was never supposed that a vessel of her magnitude would ever be built; her dimensions are 222 ft. in length between perpendiculars, 37 feet beam, and 26 feet deep in the hold, burthen 1750 tons, B.M., she is to be fully rigged as a 50 gun frigate, the length of main mast to be 90 ft. and 33 inches diameter, main yard 79 ft. and 22½ ft. diam. in the slings, foremast 83 ft. and mizen mast 76 feet, she will be able to spread 6,400 yards of canvas. There are three decks, the upper one to be left entirely clear for action, and to be pierced for 44 guns, the windlass and capstan gear will be placed 'twixt decks. She is to be propelled by Smith's Archimedean Screw, which will be 12 ft. diam. and 14 ft. pitch, but the length will be only 7 ft.; it is to make 88 revolutions per minute, the gearing consists of a cog wheel 20 ft. diam., working into a smaller wheel of 5 ft. diam., upon whose axis is the shaft of the screws. The engine power consists of two cylinders 68 in. diam., 4 ft. 6 in. stroke, and to make 22 strokes per minute, nominal power 306 horses; there are to be four air pumps 19 in. diam. and 4 ft. 6 in. stroke, and 3 cylindrical boilers. The engines are to be placed close abaft the vessel, leaving the midships clear for passengers.

A very beautiful stained glass window has recently been put up over the altar of West Hackney church, the centre part of which is a copy of the celebrated altar-piece at Magdalen College, Oxford—Christ bearing the cross, very finely coloured, from the original picture; and on either side stand out in bold relief the figures of St. Paul and St. Peter, after Raphael. They stand in niches, which have a very striking effect, the metal work being so contrived as to have the appearance of one sheet of glass. The whole of the subjects have been got up in a masterly style, are beautifully drawn and coloured, and reflect much credit upon Mr. Holder, the artist, of Gray's-inn Road. We understand that the subjects were selected by the excellent taste and judgment of the rector, the Rev. Mr. Birch, and at whose sole expense the whole has been completed.

Marylebone Paving Association.—This Association for the improvement of Street Paving is one highly worthy of the consideration of the professions, and of the support of those interested in the parish of Marylebone. We shall enter upon the subject of wood paving next month.

Conservative Club.—We understand that the designs for the new building are entrusted to Mr. Sydney Smirke, and Mr. Basevi, who are appointed conjointly architects for carrying out the design, which it is reported will be upon a magnificent scale.

St. Austen Cornwall.—An Act of Parliament has been obtained for the purpose of effecting considerable improvement in this town, and the Commissioners have decided upon erecting a new town hall and market. Designs for which were submitted in competition, and that by Messrs. Eales and Cope of Bloomsbury Square, London, has been selected by them for execution. The façade is in the Italian style to be executed in granite. The cost £5000.

Standing Orders.—In the House of Commons on Thursday, 23d ult., Mr. Wilson Patten brought forward the motion of which he had given notice, namely, "That so much of the Standing Orders of this House as obliges promoters of Railway Bills to give their notices, and to deposit their plans and sections in the months of February and March, instead of the months of October and November, be repealed." The motion was carried without the slightest opposition.

The Royal Tar, Peninsular steamer, having undergone a thorough repair in London by Messrs. Miller, Ravenhill, and Co., who have put in new boilers, thereby effecting a wonderful reduction in the consumption of fuel, went down to Southampton, and made an experimental trip, under the inspection of Mr. Lamb, the government engineer. She is now on duty with the Peninsular mails.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 28TH MAY TO 23RD JUNE, 1842.

Six Months allowed for Enrolment, unless otherwise expressed.

William Young, of Queen-street, lamp-maker, for "*improvements in lamps and candlesticks.*" Sealed May 28.

Philip Jacob Kayser, of Gracechurch-street, manufacturer, for "*improvements in the construction of lamps.*" May 31.

Henry Phillips, of Exeter, chemist, for "*improvements in purifying gas for the purposes of light.*" May 31.

Richard Watson, Jun., of Cloth-fair, gas fitter, for "*improvements in draining land embankments, and cutting of railways and other engineering works.*" May 31.

Henry Wilkinson, of Pall Mall, gun-maker, for "*improvements in unloading shipping, especially those vessels called colliers.*" May 31.

Louis Nicholas de Meckenheim, of Vienna, but now of London, engineer, for "*improvements in the manufacture of iron.*" May 31.

Henry Beaumont Leeson, of Greenwich, doctor of medicine, for "*improvements in the art of depositing and manufacturing metals and metal articles by electro-galvanic agency, and in the apparatus connected therewith.*" June 1.

William Henry Kempton, of South-street, Pentonville, gentleman, for "*improvements in the manufacture of candles.*" June 1.

James Reed, of Bishop's Stortford, statuary and mason, for "*improvements in tiles, slating, and the construction of water-tight joints, and in the covering and casing of buildings and other erections.*"—June 2.

Henry Jubber, of Oxford, confectioner, for "*improvements in kitchen ranges, and apparatus for cooking.*"—June 2.

Benjamin Aingworth, of Birmingham, gentleman, for "*improvements in the manufacture of glass, for the purpose of producing glass which may be used for the purposes to which plate glass and window glass are usually applied.*"—June 4.

Edmund Tuck, of the Haymarket, St. James's, Westminster, silversmith, for "*improvements in the covering or plating with silver various metals and metallic alloys.*"—June 4.

William Irving, of Regent-street, Lambeth, engineer, for "*an improved corn drill, or machine for sowing all kind of seed or grain.*"—June 7.

John Woodcock, of Manchester, millwright, for "*improvements in the construction of steam-engines.*"—June 7.

James Nasmyth, of Patricroft, near Manchester, engineer, for "*certain improvements in machinery or apparatus for forging, stamping, and cutting iron and other substances.*"—June 9.

Joseph Chatwin, of Birmingham, lamp-maker, for "*improvements in the construction of cocks.*"—June 9.

John George Hughes, of No. 158, Strand, general agent, for "*a new application of telegraphic signals, and the mode of applying the same.*"—June 9.

James Anthony Emslie, of the Borough and County of Newcastl[illegible] upon-Tyne, civil engineer, for "*certain improvements in pumps.*"—June 9.

Stephen Bencraft, of Barnstaple, gentleman, for "*improvements in t[illegible] construction of saddle-trees.*"—June 9.

Arthur Howe Holdsworth, of Brook-hill, Devon, gentleman, [illegible] "*improvements in constructing certain parts of ships and vessels in order [illegible] arrest the progress of fire, and for regulating temperature.*"—June 11.

Richard Garrett, of Leiston Works, Suffolk, agricultural instrum[illegible]nt maker, for "*improvements in the construction of horse-hoes, scarifiers, drag-rakes, and drills, for cultivating land.* June 13.

Thomas Banks, of Manchester, engineer, for "*improvements in the construction of wheels and tyres of wheels, to be employed upon railways.*"—June 13.

Moses Poole, of Lincoln's-inn, gentleman, for "*improvements in obtaining the colouring matter from wool, and woollens dyed with indigo.*" (Being a communication.)—June 13.

William Cotton, of Leytonstone, Essex, Esquire, for "*an improved weighing machine.*"—June 13.

Daniel Williams, of Oxford, slater, for "*improvements in covering ridges and hips on the roofs of buildings.*"—June 13.

Isaac Moss, of Macclesfield, Cheshire, silk trimming manufacturer, for "*improvements in the manufacture of covered buttons, ornaments and fastenings for wearing apparel.*" June 13.

William Morrett Williams, of Bedford-place, Commercial-road, and of 163, Fenchurch-street, lock manufacturer, for "*improvements in the construction of locks and keys, which he proposes to call "Williams' lock and key improved.*"—June 13.

Henry Hough Watson, of Bolton-le-Moors, consulting chemist, for "*improvements in bleaching, changing the colour of, and otherwise preparing, purifying and refining tallow, and certain other organic substances, mixtures, compounds, and manufactures.*"—June 21.

Joseph Bunnett, of Deptford, Kent, engineer, for "*improvements in pavements, for streets, roads and other surfaces, and in machinery for producing and repairing the same.*"—June 21.

John Dickson, of Brook-street, Holborn, engineer, for "*improvements in rotary engines and boilers, in stopping railway carriages, and in machinery for propelling vessels, part of which improvements are applicable to propelling air and gases.*"—June 21.

Frederick Gye, jun., of South Lambeth, gent., for "*improvements in binding pamphlets, papers and other documents.*"—June 21.

Thomas Gaunt, of 10, Dalby-terrace, City Road, gent., for "*improvements in the means of applying any such power as is or may be used for propelling vessels or carriages to produce locomotion thereof.*"—June 21.

Henry Bewley, of Dublin, licentiate apothecary and chemist, for "*an improved chalybeate water.*"—June 23.

TO CORRESPONDENTS.

"Connecting Rod"—*The question of Long and Short Connecting Rods has already occupied a considerable portion of the Journal.*

Seyton's communication will appear next month.

B. G.—*If the engine of* 10 *tons weight be of just sufficient power to draw a train of* 50 *tons weight at* 20 *miles an hour on an even plane, it will require* 68-100*ths additional power to convey the said train at the same rate up an inclined plane of* 16*ft. in the mile, and double the power up an inclined plane of* 24*ft. in the mile.*

"Beale's Rotary Engine."—A. H. P.'*s remarks on this engine came too late for insertion this month; we think they had better be deferred until we have reported some farther experiments that are about to be made, which will appear in the next month's Journal. In our account of the performance of the "Anti John Scott Russell" we omitted to notice that the distance from London Bridge to Greenwich, performed at the first trip in* 39½ *minutes was* against a strong tide.

T. F.—*We are compelled to defer this communication until next month.*

Books Received—Memoirs of the Literary and Philosophical Society of Manchester, Vol. VI.; Mr. Grantham's work on Iron Ship Building; and "On the Use of Mechanical Power;" which will be noticed next month.

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 35th instant.

Vols. I, II, III, and IV, may be had, bound in cloth, price £1 each Volume

ERRATA.

Strawberry Hill.—In our last number, the engraving is stated to be the "Ground Plan," instead of which it ought to have been the "Principal Floor"; and instead of letter *e* in the recess, it should have been *r*; and the opening shown as a door should have been a window; the letter *e* ought to have been placed opposite to the window of the room C.

Page 205, col. 2, line 3, of Reviews, for Practical *Geology*, read Practical *Geodesy*.

THE THREADNEEDLE STREET STRUCTURE.

PUBLIC attention has been excited in a very unusual degree by this building. And no wonder: for, in the first place, the character of the design is in many respects not a little striking in itself; in the next, people were quite taken by surprise when, the scaffolding or screen before it being removed, they beheld what, for this country, may be termed an almost unprecedented display of sculpture; and, in the third, their curiosity is the more excited, because no one as yet positively knows for what definite purpose the edifice is intended. To these circumstances may be added one which nowise tends to diminish public astonishment and admiration, namely, that the building is altogether the enterprise of a private individual (Mr. Moxhay), who has shown in it a degree of taste and liberality quite exemplary; certainly an example that we trust will be followed, and, moreover, one that reproaches not a few of our recent structures, both on account of their insignificant character, and the paltry economy manifested in them. With the exception of the *insula* or group of architecture formed by the Athenæum, Travellers', and Reform Clubhouses, the other buildings about town, even of that class, from the "City Club" in Broad-street to the sulky "Oriental" in Hanover-square, are, whatever they may be in regard to internal accommodation, more or less poor and abortive in point of design—the works of mere builders, not of architects. The same remark applies to the offices belonging to many assurance and other public companies. If not the buildings themselves, the designs are for the most part propped up entirely by columns or pilasters, for there is generally nothing else architectural about them; and those might very well be spared altogether, as being not only useless in themselves, but because they become ridiculous affectations when mixed up, as is usually the case, with mean and insignificant features, which are thereby made to look some degrees more mean and trivial than they otherwise would. We have heard it urged as an excuse, that in most cases all the money which can be allowed, or that people choose to allow, for external decoration is swallowed up by columns, so that the rest must be put off with what is more expressively than elegantly termed "a lick and a promise," with a few streakings after "scored pork" fashion for rustication, and a few meagre mouldings to doors and windows. If absurdity be an excuse, the excuse just alluded to is valid enough, of all reason; for why should columns be introduced at all for mere decoration, if for the sake of having them every other part must be deprived of due embellishment, and the whole consequently rendered a maimed, inconsistent, botched-up affair, a ridiculous mixture of the would-be fine and the must-be paltry? We had hoped that the examples of the Travellers' and Reform Clubhouses (more especially as the former has been published as a study for architects,) would at once have clapped an extinguisher upon the miserable "pseudo-classical" system, of which the only recommendation is that it requires no study or invention whatever, but merely *nous* enough to be able to copy columns and antæ from Stuart's Athens, or other publications of the kind. Thus one man's Grecian is just as good as another's; and, with hardly an exception, the mark of the Beast is upon that of them all. Whether Mr. Moxhay's building—which we ourselves have here almost turned our backs upon—will have the effect of now spiriting up others, both professional men and their employers, to emulate his example, is what time must show. In itself it certainly is a very superior specimen, and a far greater public ornament than many of what are called public edifices; which is no great compliment, by the bye, some of the latter being little better than so many public deformities. Perhaps it is well, therefore, for them that it is neither next door or opposite neighbour to any one of them; for even now it puts us quite out of conceit with some of the newly-erected buildings in its vicinity—with the two fire offices at the corner of Bartholomew-lane, and the Wesleyan Missionary Hall in Bishopsgate-street; although if columns—no matter how they may be introduced—are sufficient to constitute grandeur or beauty, the buildings just mentioned possess a decided advantage over the one in Threadneedle-street. The façade of this last is exceedingly simple in composition, for it consists of no more than a door and two windows on each side of it, between which and the entablature is a deep panel extending nearly the entire width of front, and filled with a relief, the figures of which are little less than the size of life, and not being placed at such a distance above the eye as sculptural decoration of the kind usually is, wherever applied at all, they possess a degree of importance in the design that would be lost were they elevated fifteen or twenty feet higher. Hitherto, wherever sculpture has been introduced at all in the front of a building, it has been either in little bits and patches, or else placed where it cannot be properly seen as a work of art, but merely as ornament and accessory embellishment, valueless and unmeaning in itself, although it may serve to give an air of richness to the architecture. We perceive that there are panels with reliefs in the attic of the front of Buckingham Palace, and that is all that can be seen or understood of them. In such cases there is no situation from which the sculpture can be properly seen, for the nearer we approach the building in order to obtain a distinct view of it, the more are the figures foreshortened, and so far distorted; and almost any scratches and scrawls would therefore answer the purpose as well, either for a near or distant view.

Though the building in Threadneedle-street owes its character chiefly to Mr. L. M. Watson's labours—the author of the noble and poetically-conceived and tastefully-executed piece of sculpture which is now attracting so much attention—it is not without more than usual degree of embellishment in other respects, having a carved frieze and rich cornicione. The former, indeed, is not altogether so satisfactory as could be wished, for the *rabesco* or foliage is too stiff and formal in contour; and it is also to be regretted that a little more embellishment was not bestowed upon the door and windows, which now look too plain for the upper part of the front. Still, taking it altogether, this façade is incontestibly one of the most striking, original, and artistical pieces of architecture in the whole metropolis; beyond all comparison superior to those masses of collective littleness or of spun-out common-place, and frigid dulness and meanness which, because they are great, are looked upon as being also dignified and grand.

While the patrician and aristocratic patrons or would-be patrons of art and pretenders to taste do not care to exhibit other architectural taste *pro bono publico* than what may be seen in such spruce specimens of it as Stafford House, and the very *neat* yet certainly very piddling and anything but dignified mansion of the "Great Duke," or as the brick wall in Duchess-street, which looks like the entrance to a manufactory, or brewery;—while such, we observe, are the architectural specimens exhibited to us by the opulent and the great, a comparatively humble individual—and what is worse, a man in the "city"—one, therefore, in whom it is little less than insolence to pretend to taste at all—has shown a degree of spirit, liberality, and taste, infinitely more creditable to himself and advantageous to the sculptor who has had the opportunity of displaying his talents upon such a scale, than it is likely to prove at all favourable to many other buildings, which now look more paltry than ever, when contrasted with Mr. Moxhay's.

Not the least curious part of the matter is that on this occasion there has been none of that fussiness—generally "much ado about nothing" fussiness—which so frequently takes place; as, for instance, in the remarkably silly business of the Nelson Monument, when, after two *humbugging* competitions, nothing better could or was allowed to be chosen than an overgrown nonsensical column, for which no design whatever was required beyond the mere working drawings. We are afraid, too, it will be found after all that the very best choice of all has not been made in regard to the Royal Exchange,* although the design is certainly superior to the majority of those sent in, and very far superior indeed to the one that, to the utter astonishment of every body, obtained the highest premium!

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* Even were that part of the adopted design very much superior in point of design to what it is—at least, if we may judge from the views published of it—the idea of making the Exchange itself—the area where the merchants will assemble and transact business—a mere open court, is so truly preposterous—such a practical absurdity—that we trust it will never be carried into execution. The citizens must be dreadfully afraid indeed of *smotheration*, if apprehensive of being smothered *en masse*, were the Exchange to be covered in. We wonder they do not feel similar alarm at their Guildhall banquets, and instead of talking of a new roof for that structure, do not propose that it

Equally, or even still more curious is it, that the design for the building in Threadneedle-street is by Mr. Moxhay himself. We do not vouch for the truth of this: it may be mere report, but it has never been contradicted or called in question; and, at all events, there is every reason for believing that, whoever may have made the actual drawings, the ideas for the design are entirely Mr. M's own, the whole being in character altogether different from that observable in any other building about town, and from the manner of any other architect. It is easy enough, therefore, to decide negatively, and say who could certainly not have had any hand in the design. Hardly any professional man would have ventured to propose sculpture upon such an extensive scale, or have thought of making that predominate in the decoration, to the utter exclusion of columns, pilasters, and other usual *"properties"* of architectural composition. Much more likely is it that a "classical" architect would have said—for such was actually the case in respect to one of the designs for the Royal Exchange—that the sculpture might be omitted altogether, without in the least injuring the general character of the building. In the opinion of such a one, a blank panel would produce nearly as good an effect as Mr. Watson's relief. Very rarely indeed does architecture extend any patronage to sculpture in this country, otherwise than as mere heraldry, allowing the sculptor to perform the part of coach-painter, and insert a tiny ducal coronet, or some Gothic armorial bearings and their supporters within the pediment of what is intended for a *Grecian* portico. Of classical sculpture to any extent in this country, we have indeed one example in the series of Homeric subjects which adorn the exterior of the Marquis of Bristol's mansion at Ickworth; and we have now just got another in Threadneedle Street.

Before putting aside our pen, we have to remark that the removal of the French Protestant Church—a very ugly building in itself, although of nearly the same physiognomy as almost all city churches, not excepting the more *admired* than admirable ones by the "great" Sir Christopher Wren—has been attended with a double advantage; for while it has made way for the new building in Threadneedle-street, a new structure for that church is now erecting in St. Martin's Le Grand, on the opposite side of way to and at no very great distance from the Post Office. The style is Gothic, and although small, the building promises to be very far better than almost anything of the kind about town. Such is our impression at present, and we trust we shall have no reason to depart from our opinion, when the building is completed.

THE SPIRIT OF ARCHITECTURE.

It cannot, we conceive, be denied by the most resolute upholder of modern greatness, that architecture has greatly declined among us in these latter ages. The causes of this retrogression have been from time to time pointed out in this journal as due to a want of adventure among architects, and a blind adoration of the architectural forms of Greece and Rome; and these expositions have been received with the incredulity natural to men whose prejudices suggested an opposite doctrine, and who felt that the acknowledgment of architectural degeneracy involved a sort of latent censure upon themselves. We, therefore, propose to go into the subject a little more specifically, with the view of showing that it is the spirit of architecture about which architects ought to be truly solicitous, and that in architecture, as in most other things, the spirit is oftenest and most deeply violated by an indiscriminating adherence to the letter. We shall likewise have occasion to notice the present penury of real architectural skill, and the pernicious influences of the existing modes of practice and instruction; and we shall venture to suggest the adoption of certain measures, by which these evils might, we conceive, be mitigated or averted. We are too well acquainted with the untractable natures of architects to imagine that any counsel or remonstrance of ours would be much attended to, so long as it might be safely disregarded; but we believe we shall be able to show that architectural art, in the proper sense of the term, is in a very precarious condition, and that unless architects awaken from their lethargy, and do something for its advancement or regeneration, the administration of the art will pass from their hands into the hands of the new sect of decorators, or into the hands of the civil engineers, and architecture, in the ancient and proper meaning of the word, become extinct altogether. We think architects are so obviously interested in preventing such a catastrophe, that they may perhaps give some attention to the means adapted to obviate its occurrence; and we are, therefore, induced to hope that we may be heard with more patience and less incredulity than usual. The subject is manifestly an invidious one, and our remarks, therefore, require much liberality of interpretation; but we rely upon the temper and judgment of those whom the inquiry most nearly concerns—upon the absurdity of supposing that we should derive gratification from being gratuitously censorious—and upon the fact which we, once for all, assert as the key to our observations—that our animadversion is not directed against individuals, but against systems.

And we would, in the first place, remark that whatever architects may think of the present condition of their art, the public opinion is that it never was in a state of greater degradation. This opinion architects may possibly deride: they may look upon public approbation as no evidence of excellence, and public discountenance no test of demerit, and may console themselves for the public alienation by the pleasing emotions they themselves derive from their own combinations and the congenial taste of a few eccentric virtuosi. But we would beg leave to insinuate that it is not for their own gratification that architects ought to work, but for the gratification of the public; not for a little knot of odd and pedantic men, but for the great bulk of mankind; and although architects may affect to despise the popular taste as indiscriminating and uncultured, they will certainly find it much nearer the standard of unperverted truth than any taste formed in the narrow and exclusive circuit of a particular profession. Indeed we look upon the *technical* quality of the taste which architects very generally imbibe as one of the most serious hindrances to eminence in their art. Certain objects become associated in their minds with pleasurable emotion, which in the minds of other men are productive only of indifference or disgust, as anatomical preparations of the brain or intestines may appear beautiful to the medical student, though exceedingly loathsome to every body else. Every profession is apt to create particular bonds of association and particular habits of thought, which it is the aim of all sensible men to exterminate or conceal; and in an art addressing itself to the world at large, any taste deserves to be called bad which is founded upon associations accidental to a particular individual or profession, instead of upon such as are universal and indestructible. Of all errors into which the mere architect can fall, none is likely to be more pernicious than that of being too architectural—of appealing to sympathies which architects alone can feel—and relying upon classical allusions and microscopic graces which to ordinary observers are invisible or insignificant. This is a departure from the spirit of art, and a servile subserviency to the letter; and indeed it will generally be found in copying the forms of ancient structures for modern uses, the deviation from the true principles of art is in the exact proportion of the fidelity of the imitation. To architects who have been long in the habit of contemplating with little less than idolatry these creations of genius, the exact imitation of their peculiar features is likely enough to excite emotions of beauty that will be exceedingly strong; but in the minds of men in general, the prominent sentiment excited will be that such structures are altogether unfit for modern purposes, and as such are ineligible and unattractive. We therefore find that the most celebrated architects since the time of the ancients have been the greatest innovators, and what may seem still stranger, the greatest architects have not, properly

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should be unroofed altogether, especially as there are plenty of roofs on such *occasions*, each guest being provided with the roof of—his own mouth!

speaking, belonged to the profession of architecture at all. Michael Angelo was a sculptor, Sir Christopher Wren a professor of geometry; and we honestly believe that much of their eminence is due to the accident of their having been architectural interlopers. They brought to their new occupation an unsullied taste—extensive information—imagination which had never been frozen by the chill atmosphere of schools—sensibility which gilded the commonest objects with the rays of its own benignity, and which had communed with the chief aspects of nature, and the most conspicuous objects of the moral and intellectual worlds: and they poured out these accumulated treasures upon their architectural creations, and moulded inanimate matter into images of unspeakable beauty, and quickened it into life by the fire of genius; and while in the course of nature the spirits of these great men have passed away, the reflection of them still exists in their works in all its primitive majesty, and still rules the minds of other men—not by virtue of associations peculiar to any race or generation, but by such as are common to all men in all ages, and are the inseparable concomitants of the qualities by which they are awakened.

There are probably few persons prepared to maintain that there is any architect at the present day equal to those great masters, or that the condition of architectural art is as exalted now as when they flourished. The cause of this declination is, we conceive, chiefly due to the apparent paradox of architects being too solicitously educated; in other words, their education is in our eyes far too architectural. They become thus as it were a separate caste, having few or no sympathies with men in general, and their beauties are such as are not associated in common minds with any interesting impressions. They are, moreover, far too much under the influence of rules and precedent, and attach too much importance to certain recipes of beauty which are administered with too little reserve and discrimination. That there are among architects now living men of genius we do not deny, but what we complain of is, that they can on no terms be induced to *exert* that genius; they are afraid of ridicule or failure, and instead of producing works of real genius, which we are convinced many of them could do, are content with the reputation of insipid correctness, and ponderous mediocrity. This may, it is true, be a very safe policy for individual practitioners, but is certainly a very spiritless one, and is absolutely fatal to the progress of art; for how can there be improvement if there be not even adventure? Besides, this pusillanimous mode of procedure reduces architecture to a mere trade—a trade, too, of the meanest description, since it does not require even manual dexterity for its exercise. It offers a premium to dullness, by placing stupidity and genius upon the self same terms: reduces architectural proficiency to a simple acquaintance with certain lengths and breadths; and makes beauty a mere question of arithmetical computation, which the artizan is quite as competent to resolve as the artist.

One of the distinguishing features of the present age is love of novelty and of powerful emotion, and if architects continue unable to administer to the popular taste, other instruments will certainly be sought for. Many of the constructions which formerly belonged to architecture have already passed into the province of the civil engineer; and it can scarcely be doubted that all those which require the exertion of science rather than taste for their execution will speedily follow. No one now thinks of applying to architects to build bridges, or piers, or lighthouses, or anything indeed which is not to be embellished. The architects, therefore, it would appear, have already been driven from many of their strongholds: one—an impregnable one—remains with them, and that is—ART. From this position no power can ever drive them, so long as it is defended; but, with a suicidal infatuation that is scarcely credible, they appear of their own accord disposed to abandon it to their opponents. By art we do not mean the power of multiplying Grecian constructions, or of producing columns or gateways which shall be in accordance with the rule, for this the engineer or any one else is perfectly able to do; but we mean the invention of new modes of decoration and distribution answerable to particular purposes, or such a combination of old modes as will constitute in reality a new invention. Except in cases where this is done, the intervention of an architect is altogether superfluous, and if old designs are only repeated, or repeated with some insignificant modification, architects will cease to be employed; and builders will engage to produce churches or mansions, as ship-builders now produce ships, or engineers steam engines. It appears to us, therefore, to be of the last importance to architects to cultivate assiduously the art of decorative design; not after the formal and prescriptive manner they have observed hitherto, but by means calculated to promote the progress of art, and to awaken the sympathies of the community.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXXIX.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. HOWEVER bad a system of things may be—however flagrant and notorious its abuses—there are always some who are interested in supporting it, and who accordingly set their faces against any reforms in it. Little, therefore, is it to be wondered at that there should be architects who decry competition, and who would fain keep up the old system of architectural monopoly and favouritism, which worked so well for them and their predecessors, and under which they *flourished* —in many cases with the very minimum of talent, the system itself being calculated to suppress all superior talent, by affording it neither chance nor opportunity. Fortunately that system has been somewhat broken down of late years, and the consequence is that some of the "mighty ones" have been thrown into the background and the shade; and now when we look at their works, it is with wonder and regret—wonder how they could have obtained the imposing reputation they did at the time, regret that so many of the fairest opportunities—opportunities not likely to occur again, unless the buildings erected by them happen to be destroyed by fire—should have been recklessly flung away upon them. That competition has its evils and abuses is not denied; highly desirable, therefore, is it—not to get rid of competition itself, but—to check and reform the abuses now tolerated in it. Let us, however, look also at the *blessings* of monopoly and non-competition, before we decide which of the two systems works the best for the art itself, and for the public. In the metropolis alone there has fallen to the share of one monopolist—of one who may well be said to have been *unrivalled* in his profession, for the very sufficient reason that no rivals have been suffered to approach him—opportunity after opportunity, many of which might be called splendid ones. To that individual alone is the metropolis indebted for the following most distinguished architectural ornaments of it, viz.:—Covent Garden Theatre, the Mint, Post Office, British Museum, new centre of the Custom House and its "Long Room," College of Physicians and Union Clubhouse, St. Mary's Church, Wyndham Place, the Library and other buildings in the Temple, King's College (Somerset Place), and the Conservative Clubhouse, besides some others of less note and less importance. With the exception of the first-mentioned—and even that is in very equivocal taste—the rest are little better than so many architectural blanks. When you have said that their columns and antæ are, as far as they and their capitals go, accurate copies from one or two well-known and now rather hackneyed Grecian examples of such members, you have summed up all the merits of the great or we might say the big architect of the big edifices above enumerated. Pity, great pity! that he could not keep the secret of his vast genius and exquisite taste entirely to himself. How many works of pretending dullness and pompous insipidity might we have escaped, had he not met with his copyists in Foulston and others, who have covered the land with their soi-disant classical structures, with their mockery of Grecian porticos stuck on to buildings that in every other respect are of the most John Bullish physiognomy. Most strange it is that with all its rigid punctilio, its servile and superstitious reverence for classical models and precedents, the followers of this school make no scruple whatever of entirely falsifying the character of Grecian architecture, of running counter to all its principles, and expunging from it all its charm and all its sentiment—all that gives it effect, and all that renders it imposing and impressive.

II. To this most unfortunate school the study of Grecian architecture has most assuredly not proved the torch of Prometheus. Instead of kindling them by its flame, it has only smothered them in its smoke, or its smoke has served to blind the eyes of other people. Some of them may have anatomized Grecian architecture, may have cut up its carcase, and descanted upon the separate limbs and members with tolerable ability; but hardly ever have they been able to tack them together again, except in the most clumsy manner, and then it has still been but a carcase, from which the spirit that once gave it life and grace has fled, and which they are unable to revive by breathing into it a newer spirit, an operation not to be accomplished by a pair of bellows—not even by a patent Vitruvian one.

III. In the efficacy of Vitruvian bellows, however, the Institute of British Architects have, it seems, very great faith, since they have thought it worth while to collect an assortment of them. Surely the Institute must either have a good deal of cash to fling away, or have been bitten with a strange curiosity mania, or it would never encumber its bookshelves with such "venerable lumber" as the different editions of Vitruvius, not one of which, probably, either has or ever will be opened, except to look at its title-page and date. One would imagine that the library must be most abundantly stocked with other architural works of every kind, because until it was so furnished, a single copy of Vitruvius might be deemed sufficient; more especially as Vitruvius is not so very scarce an author but that a copy of his work may be obtained any day, or even picked up at almost any book-stall. Yet the Institute will have plenty of Vitruvius; it will also have nothing else—or, at any rate, very little more than Vitruvius. Certainly the gaps and hiatuses in its library are many and startling. It does not contain even a set of Wiebeking's works! In fact, to mention what it does not contain would be to make out a list, a bulky catalogue rather, of nearly all the choicest and most valuable architectural publications which have appeared on the continent for the last hundred years, and not a few English ones besides: in short, precisely that class of works which are not likely to be possessed by private individuals —at least, only a very few of them—and to which, therefore, it is all the more desirable and requisite that there should be access in the library of that body which represents the architectural profession.

IV. Arthur Parsey, who is labouring hard to mislead the public, has lately been again advertising, and otherwise doing all that he can to attract notice to his "New Science," for which he has just received a tolerably hearty lashing in the Atlas, and has there been called, in very plain terms, an impudent charlatan and quack. It certainly does require more than ordinary mortal impudence to refer, as he has done, to some of the publications which have exposed the utter absurdity of his "*Science*," and its worse than uselessness in practice—or rather its actual impracticability, without even attempting to gainsay any one of the objections brought against it, or to point out the misconceptions and prejudices, if such they be, of his opponents. And although those who have contradicted him with their pens are comparatively few, all the world—at least all the world of artists, are decidedly opposed to him, not even a single individual having adopted the Parseyan Principles of Perspective, notwithstanding that six years or more have elapsed since they were first broached. We all know that prejudice has frequently caused great opposition and mistrust at first, in the case of many inventions and discoveries, that have since been universally adopted. Yet if Mr. Parsey lays "the flattering unction to his soul," that such is the case with regard to his own, he dupes himself far more than he does anybody else. The matter is one which admits of no dispute, for if his "converging perpendiculars" really do produce a more faithful and therefore natural representation of objects, the great improvement attending such system would be as manifest at the very first as at last, because it would, in fact, be self-evident. It is idle to say that artists would still be prejudiced against it, if only because contrary to their former practice, too inveterately confirmed to be all at once laid aside. Their refusing to make use of the "*New Knowledge*" could not prevent its spreading elsewhere; their refusing to open their own eyes to the Parseyan "new light" could not hinder the rest of the world from opening theirs and being illuminated by it. If the painters—some of whom seem scarcely to pay any attention at all to perspective—did not care to avail themselves of Parsey's grand discovery, at all events the architects would hardly have failed to do so; and scene-painters would long ere this have certainly turned it to account, and have astonished and delighted the public by such very improved and *natural* mode of representation, more especially for their *bravura* architectural vistas and compositions. However, to give Parsey his due, he possesses both bronze and nerve in a most extraordinary degree; while every body else who understands any thing of perspective laughs at it, he himself stands up undauntedly and bepraises it in his own "lectures" with such rodomontade flourishes as the following (copied from one of them):—"Hail, then, the accomplishment as a British achievement, and let our native talent first reap the advantages of an improved practice." Pity that talent—native and foreign alike—turns its back on Parsey, and refuses to benefit by the advantages he so liberally holds to them.

V. There is, no doubt, some very deep and mysterious meaning in what must strike ordinary eyes as very ridiculous, namely the half white-washed and half tawny face of the building on the west side of Trafalgar Square. Is that "Union" intended as a satire upon Unions generally—both political and matrimonial? The structure certainly looks very much as if spliced together by a modern match-maker—a fashionable specimen of the compound creature termed Man and Wife. After all, the greater probability is, that there was neither satire nor joke in the matter, but that the odd diversity of complexion in the building arises from the "Club" contenting themselves with compo for their portion of it, while the "College" would have theirs of stone. Why, then, some inquisitive folks may ask, did not the architect proceed accordingly, and make the two buildings two distinct designs, instead of passing them off for a single one dressed in a motley suit?—A puzzling question! to which the most likely answer that can be given, is, that he thought it good economy to make one design serve for both, and to kill two birds with one stone.

VI. The world has had didactic poems upon almost every subject. The "Art of Cookery" has found poets to chaunt its praises and its precepts, as well as the "Art of Poetry" itself; but I do not believe that any poem upon architecture exists in any language; at least I have been unable to discover even the title of such production. And yet, methinks, the subject is one of which very much might be made in poetry. What visions of gorgeous splendour does even the very name of the Alhambra conjure up! How awful, sublime, the eternal cavern fanes of India, and the massive and many-pillared structures of Egypt. Persepolis, Palmyra, Baalbec, Ionia, Greece, the Roman and the Goth, all throng around the bard, and court his strain! But come, this is sheer rhapsody and frenzy, easily abated, however, by a dose of—Smirke. So far from being inclined to patronize poems on the art of architecture, many architects seem never to have read that of Horace on the Art of Poetry, from the first lines at least of which they might, *mutatis mutandis*, learn something, as haply the following paraphrase may show:—

Should some odd painter lovely Venus draw
In judge's wig and grave costume of law;
Or deck some legal sage in Cashmere shawl,
And feathered bonnet, how you'd stare and squall!
You'd think him mad; and fair ones cry, "Oh dear,
How droll! how monstrous! how absurd! how queer!"
You'd laugh; yet why?—not more absurd such dress
Than many a "classic" architectural mess,
Where nought agrees—no part another matches,
But all's made up of motley shreds and patches;
A daw in feathers—peacock here, there goose;
"Splendid but neat," magnificent yet spruce;
And pert as spruce—more paltry than refined,
With front all foppery, and all rags behind.

Poets and painters may invent, we grant,
So, too, were their invention not so scant,
May architects; yet not play such queer tricks,
As tack Greek columns to a box of bricks;
With Parthenon for model, build what looks
As if just sent home from the pastry-cook's;
Crowd Roman porticos with London sashes,
Or show such doggrel taste as was great Nash's.

LITHOCROMY.

Report of the Committee appointed to examine the Elgin marbles, in order to ascertain whether any evidences remain as to the employment of Colour in the decoration of the Architecture or Sculpture. Read by W. R. HAMILTON, *Esq., Honorary Fellow, at the closing ordinary Meeting of the Session* 1836-7, *held Monday,* 24*th July,* 1837.

(From the Transactions of the Royal Inst. of Brit. Architects.)

COMMITTEE appointed by resolution passed at the ordinary meeting held Monday, the 5th December, 1836, to examine the Elgin marbles in the British Museum, in order to ascertain whether any evidences remain as to the employment of colour in the decoration of the architecture or sculpture, and to report the result of their examination.

The Committee to consist of W. R. Hamilton, Esq. Foreign Sec. Roy. Soc. of Literature; R. Westmacott, Esq., R. A.; C. L. Eastlake, Esq., R. A.; C. R. Cockerell, Esq. R. A., Hon. Fellow; Dr. M. Faraday, F. R. S., Hon. Member; and Messrs. Angell, Donaldson, and Scoles, Fellows.

ELGIN ROOM, BRITISH MUSEUM.—At a meeting held on Tuesday, the 13th of December, 1836; present, R. Westmacott, Esq., R. A.; C. Eastlake, Esq. R. A; Dr. Faraday; Messrs. Angell, Donaldson, and Scoles; as also Messrs. Forshall and Hawkins, officers of the Museum; T. L. Donaldson stated that Messrs. Hamilton and Cockerell, being at Cambridge, had written to say they could not attend.

The attention of the Committee was first directed to fragments Nos. 127 to 130 inclusive, in black, being Nos. 252 to 255 red, portions of the Ionic antæ capital and continuous mouldings of the hexastyle portico of the Erectheum. The object was to ascertain whether the inequalities of the surface of certain portions of the plain faces arose from a coating of some substance originally placed upon the surface of the marble, for the purpose of receiving the colour or paint, or whether it resulted from the action of the weather.

It appeared, upon examination by a powerful glass, that the raised portions, which remained in some parts, and which had a deeper ochrish tone than the rest of the marble, was the original surface highly polished, and that the general surface of the marble had been pretty equally worn away to the depth of about $\frac{1}{20}$ part of an inch by corrosion.

The ochrish tint also seemed the result of the weather, as upon examining portions of this and other blocks of marble which were broken, the fractured surface presented in some parts a like colour, produced evidently by the action of the weather, or other accidental circumstances, such as contact with the earth, &c.

The committee then proceeded to examine the fragment marked No. 154 in black, and No. 260 in red; No. 260 being a portion of one of the beams of the propylea of the Acropolis at Athens. The fascia presented evident marks of coloured meandering ornament, and upon washing the surface the outlines of the meander were found to be marked or indented with a sharp tool. The whiter part has the surface polished, but the surface of the darker portion is rough. The committee could not decide whether the darker tone resulted from the stain produced by the atmosphere, or rather the dust and dirt of the air, which would adhere more to the rougher surface of the marble, or whether it arose from the original application of paint or colour; but the presumption is in favour of the atmosphere or dirt, as the dirt or colour readily washed off with a sponge.

The committee were unable to decide whether the parts now smooth and rough were originally in that state, or whether the part now rough has become so in consequence of the action of the atmosphere upon it, the smooth part having been protected from that action by gilding or colour.

No. 308 in black, now 131 in red, at the north end of the Elgin room, and upon which the capital from the propylea of the Acropolis of Athens is placed, is a larger fragment of the same part of the propylea as No. 260, and the ogee bed moulding is preserved entire, with the leaves distinctly apparent on the surface. Upon being moistened with a sponge, it was evident that the outlines of the ornamental leaves and stems were engraved with a tool,* and that the darker parts of the ornaments were rough on the surface.

Sarti the modeller being present, who has been employed for many years by the trustees of the British Museum, being now engaged in taking moulds of the whole series of the Elgin Marbles belonging to the Parthenon, stated to the committee that he had never been able to discover traces of paint or artificial colour on any of the figures of the bas-reliefs, metopes, or sculptures of the pediments, although his attention having been originally drawn to the subject, he had carefully examined every portion of the surface of each figure, for the purpose of ascertaining whether any traces or signs of colour were to be found. He stated also that the whole surface of the marbles had been twice washed over with soap leys, subsequently to their having been moulded on former occasions, as that or some strong acid is necessary for the purpose of removing the soap which is originally put on the surface in order to detach the plaster of the mould. Dr. Faraday was of opinion that this circumstance was of itself sufficient to have removed every vestige of colour, which might have existed originally on the surface of the marble.

The committee then proceeded to examine two Athenian tiles in Room VI. of the Townley Collection, their attention being directed to them by Mr. Hawkins.

They are of terra cotta, covered with a thin coating of fine stucco, the surface of which is decorated with the meandre, and honeysuckle, and lotus-leaved ornament. The surface being moistened with a wet sponge, three different colours were perceptible, a white (or tone of the ground or plaster), green of a darkish untransparent tone, and a deep red in small portions, of unfrequent recurrence in the pattern or composition.

It occurred to the committee that where these architectural enrichments were employed in large quantities, it is probable that the mode of forming them might have been similar to that adopted by decorators at the present day, known by the term stencilling. The fragment in question was hardly of sufficient length to enable the committee to decide whether this method was adopted, or whether the enrichment was done by hand.

1st June, 1837.—At a meeting of the committee held in the Elgin room of the British Museum, present, Messrs. Hittorf, Hamilton, Westmacott, Angell, and Donaldson, the minutes of the previous meeting were read, as also the following letter:—

Atherstone Hall, April 17, 1837.

"Mr. Bracebridge is happy to forward a memorandum of patterns and colours from the Erectheum; they are drawn from the northern portico of that conjoint temple of Minerva Polias, Pandrosus, and Erectheus, so well known in the Acropolis. This side of the temple, being so well sheltered from the sea breeze, has presented its sculptured ornaments as fresh and sharp as if lately finished; and the columns of this portico being fluted with capitals elaborately worked and well sheltered, have retained remains of colour. At the top of the flutings especially, a thin coat of slate-coloured paint is visible, at other points yellow and red color may be traced; but the remaining pieces are so small, and the colours *so much* faded, as to leave the subject in dispute; this being alone certain, that there was colour once carefully applied (at all events to the intaglio parts of the relief or concave parts of the capitals, &c.), and that this colour was of various shades; the protuberant part of the work retains no colour. The probability that blue, red, and yellow were used is very strong. Some portions of paint might be chipped off and subjected to analysis, which would determine what there is, in truth, but little or no doubt of.

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* Might not this mode of engraving the outline have been for the purpose of preventing the colour from spreading beyond the pattern, as well as for giving a sharp and distinct outline to the ornament?

"Mr. Bracebridge has not examined the capital in the temple of Theseus, said to bear marks of paint, but he believes much the same could be said of it as above of the Erectheum.

"In the winter of 1835-6, as Mr. B. has stated in his letter to Mr. Wordsworth, printed at the end of 'Athens and Attica,' an excavation was made to the depth of 25 feet at the south-east angle of the Parthenon; here remains were found of huge blocks of marble fresh from the quarries, chippings, &c.; and below these, fragments of vessels, pottery, and burnt wood. No one who saw these could doubt that a level was dug down to below that where the workmen of the Parthenon had thrown their refuse marble, in fact the level of the old Hecatompedon, of which possibly the burnt wood may have been the remains. *Here* were found *many* pieces of marbles, and among these fragments parts of triglyphs, of fluted columns, and of statues, particularly a female head (the hair in nearly the costume of the present day). These three last mentioned fragments were painted with the brightest red, blue, and yellow, or rather vermillion, ultramarine, and straw colour, which last may have faded in the earth.

"These curious specimens are carefully preserved in the Acropolis, but much fear is entertained of their retaining the brightness of their highly contrasted colours for any length of time. The colours are laid on in thick coats. The female face had the eyes and eyebrows painted. When we consider the brilliancy of Pentelic marble when fresh worked, there appears a reason for using colours beyond that of imitating the usages of Attica in more ancient temples, namely, that the minutiæ of the work in many parts would have been lost to the eye amidst the general brilliancy."

Mr. Donaldson informed the committee, that having in his possession various portions of coatings taken by him from several buildings at Athens, he had forwarded them to Dr. Faraday, Hon. Member, with the request that he would be pleased to furnish the committee with his opinion upon the composition of such portions of coatings; to which he had received the following reply.

"*Royal Institution*, 21*st April*, 1837.

"MY DEAR SIR—I return you the box, with the remains of the samples.

"A. Portion of coating taken from the antæ of the Propyleum. The blue produced by carbonate of copper: wax being mingled with colour.

"B. Portion of coating taken from the soffits of the mutules of the Theseus. The blue is a frit or vitreous substrance coloured by copper. Wax is present here.

"C. Portion of coating taken from the columns of the Theseum. I am doubtful about this surface. I do not find wax or a mineral colour, unless it be one due to a small portion of iron. A fragrant gum appears to be present in some pieces, and a combustible substance in all. Perhaps some vegetable substance has been used.

"D. Portions of coatings from the caissons or lacunaria of the Theseum. The blue is a copper frit or glass, with wax.

"E. Portions of coating from the northern wing of the propylea. The colour, a carbonate of copper. Wax is present.

"F. Ditto, ditto (north wing propylea), as E.

"I also return you the drawing and the letter.

"Ever truly yours,

"T. L. Donaldson, Esq. &c. (Signed) "M. FARADAY."

In order to ascertain whether a portion of the surface of the statues of the Fates, which presented an ochrous tint and a more glossy surface than the other parts, was due to some foreign matter artificially applied to the surface, some parts were peeled off easily from the back of one of the figures on the application of a penknife. These *were also submitted to Dr. Faraday*, who reported as follows.

"*Royal Institution*, 8*th June*, 1837.

"MY DEAR SIR—The particles you sent me seem to have come from a prepared surface. Being put into a dilute acid, a portion of adhering matter is dissolved, and the principal portion is left in an untouched and cleaner state. Being then washed and dried, it is found that this consists of carbonate of lime and a combustible substance which protects the carbonate from the acid. This combustible substance when heated is destroyed, leaving charcoal, and then acid can attack the calcareous matter. The combustible substance may perhaps contain wax, but it does not present undeniable traces of that body. It is in small quantity as compared with the wax present in Mr. Donaldson's specimens. There is no mineral colour present in the particles, except it may be a small portion of iron colour, and that I rather judge to be accidental. Whether or no any animal or vegetable colour had been used is more than I can say.

"I am, dear Sir,
"Very truly yours,
"W. R. Hamilton, Esq. &c. (Signed) M. FARADAY."

The secretary also submitted to the committee various portions of glass eyes, which he had taken from the torus between the volutes of the Ionic columns of the tetrastyle portico of the Triple Temple in the Acropolis of Athens. They are of four various colours.

On this occasion also M. Hittorff, having a series of drawings of his restoration of the Temple of Empedocles at Selinus, restored by him and coloured in its several parts according to his opinion of the polychromatic system as applied to architecture, favoured the committee with a full explanation of the grounds upon which he had applied colour to the various parts of the edifice.

The committee then proceeded to examine the several marbles alluded to in the first report, and were satisfied with the accuracy of the former observations of the committee.

Upon a consideration of all the facts contained in the preceding minutes, it appears to the committee, that there remain no indications whatever of colour artificially applied upon the surface of the statues and bas reliefs, that is, upon the historical sculpture. That, according to Dr. Faraday's opinion, those portions of the marble which from the tone and surface might be supposed to be the result of colour applied thereon, are the original surface of the marble stained by the atmosphere, the presence of iron in the marble, or by some such natural cause. That some of the architectural fragments present indisputable traces of tone indicative of regular architectural ornaments, and that the outlines of such ornaments are distinctly traceable, being marked with a sharp instrument upon the surface of the marble. The committee cannot positively state, from the appearance of the marble, that such tones have been produced by colour, as they think that none of the colour itself remains, but that the indication of tone results from mere variation of surface. Judging, however, from the information contained in Mr. Bracebridge's communication, there appears no reason to doubt that colour has been applied. This is confirmed by the portions of coatings brought from Athens by Mr. Donaldson and analyzed by Dr. Faraday, who has detected frit or vitreous substance and carbonate of copper mixed with wax and a fragrant gum. This analysis proves that the surface of the marble of the shafts of the columns of the Theseum, and other parts of the edifices from which these specimens were taken, were covered with a coloured coating. The glass eyes also of the Ionic capitals of the tetrastyle portico in the Acropolis at Athens prove, that various materials were employed by the Athenians in the decoration of the exterior of their marble buildings.

But although the statues and bas reliefs of the Parthenon, at least those portions of them preserved in the Elgin collection, do not afford any evidence of the use of colour, yet there is a constant repetition of small circular holes in the horses' heads and manes, and in one hand of each rider, showing that there had been originally bridles and straps to the horses, either of metal, leather, or some other similar substance. Similar holes are perceptible in the statue No. 94 (in red) of Proserpine, one of the two female figures of the eastern tympanum of the Parthenon, called also the Seasons or Hours; they are in the arm just above the wrist, apparently for the purpose of attaching bracelets, and in the shoulders at the junction of the drapery, as though a metal rosette had been affixed there. On the neck of one of the Fates No. 97 (in red) are also two holes, which seem to have been for a necklace. In the back of the torso of Victory No. 96 (in red) are large holes, in which it is supposed bronze wings were fastened. No. 101 (in red) is a fragment of the upper part of the head[*] of Minerva; the sockets of the eyes are hollow, and were evidently filled with metal or with coloured stones, and holes remain in the upper part of the head, affording the presumption that there was originally a bronze helmet attached to the marble. The angles of the Ægis of No. 102 (in red), which is a fragment of the statue of Minerva, one of the principal figures of the western pediment, are drilled with holes, by which the metallic serpents were attached, and in the centre a head of the Gorgon.

THOMAS L. DONALDSON, Hon. Sec.

THE ARCH IN ARCHITECTURE, ITS ORIGIN, FORMS, AND PROPORTIONS.

THE oblique arch having so prominently occupied the pages of the *Journal*, there being ten papers on that subject, and only one on the arch itself, by Mr. Frederick East, Vol. 2, page 354, has induced me to offer a few observations. Mr. East states, on the authority of Livy, Virgil, Herodotus, Ktesias, and Strabo, that, probably, the arch was instrumental in the construction of the hanging gardens of Babylon, built B. C. 1200; but that certainly the arch was known in Assyria, as also in Lydia, which latter country was subdued by the Babylonians about the period above mentioned; and with respect to the Roman works of the "Avaca maxima," said to be commenced by Tarquinius Priscus, and finished by his grandson Tarquinius Superbus, 7th King of Rome, Ferguson in his Roman Republic, hints that they may be the relics of some city previous to the erection of Rome. From these authorities there can be little doubt but that the arch was in familiar use at an early period, but unknown in Greece till within a century of the Christian era.

This subject engaged my attention several years ago at a very early age, in consequence of the prominence given to the five orders over the arch, which, in my humble opinion, was worthy of a more prominent place; the only works known to me at that time solely devoted to it, being, a treatise published in 1772, by Dr. Charles Hutton, and Attwood on the construction and properties of arches; since that the following authors have come to my knowledge:—Semple, Telford, Ware, Smeaton, Milne; and of foreigners, French—Perronnet, Gauthier, Borsland, Bruyere, and Belidor; and of Italians—Alberti, Palladio, and Serlio. First let us consider what an arch is; the term is derived from the Latin *arcus*, a bow, and has been defined to be a concave structure raised upon a mould called the centreing, in the form of the arc of a curve, serving as the inward support of some superstructure; also as part of a circle less than a semicircle; as a hollow building raised upon a mould in the form of a semicircle; as a contracted vault; and as an artful disposition of stones generally in a bow-like form, by which the weight produces a mutual pressure and abutment, so that they not only support each other and perform the office of an entire lintel, but may be extended to a great width, and made to carry the most enormous weights. There being no word in the Greek language meaning an arch, it is inferred that the object was unknown, although it has been said that the pediment of the Greeks suggested the arch, and it has been found in the Temple of the Sun, at Athens, and of Apollo at Dydamus, concealed in the walls, covering the necessary openings, perhaps similar to discharging arches as now used by the moderns. In sacred history the arch is first mentioned in Ezekiel, chap. 40, v. 16, in his description of the Temple. "There were narrow windows to the little chambers, and to their posts within the gate, round about, and likewise to the arches, and windows were round about inwards, and upon each post were palm trees." B.C. 574. The bridge over the Euphrates, at Babylon, Herodotus expressly says, was built on stone piers bound with lead, and lintel or squared beams of timber. The tunnels also at Babylon, mentioned by Diodorus Siculus, were probably covered in the same way. Visconti, on the authority of Plutarch, assigns the invention to Alexander himself, who lived B.C. 323, or about a century after Herodotus; Dr. Pococke thinks the Egyptians were unacquainted with the arch, although Belzoni found Egyptian arches at Thebes, and one at Gouinon, leading to the valley of Beban el Malook, and Diodorus Siculus, in describing one of the celebrated buildings of Egypt, takes particular notice that it was tipped with one stone; Sir John Chardin, in describing the subterranean passages at Tohelminar, does not in any way allude to the arch, a circumstance he would not have omitted if it had been the case; one tomb is said to be arch-roofed, but it is in solid rock.

The Romans have the merit of being the first to introduce the arch into general use. The earliest on record is the conduit at Tusculum near Rome, 16 ft. wide, and 30 ft. high. The second, the theatre of Marcellus at Rome, built in the time of Julius Cæsar, where semicircular arches are found, and I think it may with truth be said, a genuine arch did not exist prior to the time of the Romans. With the remarks of your former correspondent I agree, that the arch was not known in Greece, and I think there is doubt of its being used at Babylon, or Assyria, or in Rome, earlier than the time of Cæsar, B.C. 50. In the quotation given from Ezekiel, it appears to me that the true arch is meant, as the impost was the earliest ornament in arches of stone, and that, too, with leaves resembling those of the palm. This would place the invention nearly 500 years previous to the time of Cæsar. Again, the absence of any remains is a great obstacle to the latter conclusion, so that we must be content to allow the merit to the Romans of bringing the arch into general use, but the extent of its application was reserved for modern times, as Waterloo, London, Gloucester, and Chester Bridges amply testify.

There are the following forms of arches in use; the date of their introduction is almost as uncertain as the origin of the arch itself:—

Tudor Arch, called after the name of the reigning family.

Arched Dome, which arose in Etruria.

Semi, or Roman, in exclusive use until the 12th century.

Horse-shoe, or Moorish, more than a semicircle, found in East Morgan, a building of the Anglo-Normans.

Elliptic, first found in the tower of the Deanery of Lincoln, 1500.

Inverted Arch, found in Cathedral of Wells and Salisbury.

Catenarian, or Arch of Equilibration.

Scheme or Skene, or Imperfect Arch, less than semicircle.

Hyperbola, and Parabolic, from sections of a cone.

Trochoid, or Cycloid, invented by Descartes, 1615.

Epicycloid, formed by motion of a point in a paddle-wheel of a steam boat, a combination of circular and progressive motions.

Pointed Arch, first occurs in church of Friendsbury, built by Paulinus the Sacrist, 1137; called also the Saracenic Arch. Supposed to be introduced from the Crusaders, although more probably it took its rise from the intersection of two circular arches, called interlacing, an example of which is in Kelso Abbey.

There are 22 varieties, drawn from four, six, and eight centres.

Straight Arch, or Plat Band, with joints converging to a common centre, an example, Lincoln Cathedral and Greenwich Hospital.

Vaulting or Groins, the latter arises from the intersection of the former, about the 11th century.

Rampant or Flying Arch, used to connect buttress and pinnacles with the main building.

Having stated as much as I can learn as to origin and different forms of arches now in use, the most important part of the inquiry remains—the proportions of the arch in its adaptation to bridge building; the different forms, as circular, segmental, and elliptic, must be considered more as dependent on situation. The proportion of parts has generally been estimated in parts of the span or chord, and $\frac{1}{15}$, $\frac{1}{22}$, up to $\frac{1}{34}$, has been stated as the proper depth for the voussoirs at the crown or apex—the thickness of abutment $\frac{1}{3}$ of the span, and of the piers $\frac{1}{6}$. The rise or versed sine should not in any case be less than $\frac{1}{4}$ of the chord. When the height of the piers exceeds the rise of the arch, an addition of $\frac{1}{5}$ (if their size be estimated by the previous standard) is made to their thickness, and when the span of the arch exceeds 50 feet, it is usual to increase the voussoir, as the abutment or skewback is approached. The success that has attended Mr. Brunel's bold experiment of the Maidenhead Bridge, carried into successful execution amid the sneers and jibes of his compeers, in the application of brick to a span for which, a few years ago, no stone save granite was considered competent, augurs favourably for the use of arches of brick to an extent never before contemplated, especially where high banks offer the additional inducement to try the effect, there being then no approaches to make. The Maidenhead Bridge is turned in half-brick rings in cement, 5 ft. 3 in. in depth at the Crown, and 7 ft. 1½ in. at the springing; the two main arches are elliptic, and 128 ft. span, with a rise only of 24 ft. 3 in.; the land arches are 21 ft. and 28 ft. span, there being six of the latter on one side and two of the former on the other. The immense mass of 7 ft. in depth of brick in the arch is, in my opinion, the true source of security.

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[*] This fragment alone may *perhaps* be considered as an exception to the previous statement, that no evidences of colour existed on the statues or figures of the Parthenon. The hair appears to have a red tint, which becomes distinctly apparent upon the application of water.

The proper position of the joint in complex figures, such as the ellipse, parabola, and cycloid, is a good exercise in geometry; the position of the joint should be perpendicular to a tangent at that point. I feel confident that arches of stone might be constructed twice their present extent as regards span; there would be no danger of compression of the materials, as the cohesive power per square inch of granite, sandstone, and Bath stone, are respectively 2800, 896, and 755 lbs, the weight per cubic foot of each material being 173, 144, and 92 lbs.

Newcastle-upon-Tyne. O. T.

The following works have been consulted:—The C. E. & A. Journal; Elmes on Architecture; Woodward on the Wisdom of the Egyptians; Sir James Hall's Origin of Gothic Architecture; Stuart & Rivet's Athens, and Stuart's Dictionary; Papers by Stukely, Gunn, and Sir H. Wotton, in the London Archæologia.

NOTES ON STEAM NAVIGATION.

Holding down bolts.—Those which go through the bottom of the ship, if of iron, are very quickly eaten away. It is a usual and beneficial practice to tin them before they are inserted, but even in this case they do not last very long; the tinning is probably in most cases injured in driving the bolt: zincing would be better. When the vessel has much rise of floor, and the keelsons are consequently very deep, and the bolts therefore very long, it is often very inconvenient to get the bolts introduced at all, especially if the vessel draw much water; for the blocks upon which the vessel has to be placed in the dock require to be very high, and when high there are few docks in which there is a sufficient rise of water to enable the vessel to surmount them. It has, therefore, been found expedient in some cases to make the holding-down bolts with a nut at each end, and to reeve them from above; but in such cases it is almost indispensable that the bolts should be of copper or Muntz' metal. If of iron the threads of the screw would be soon worn away, or the nut would get so fixed by corrosion that it would be very difficult to get the bolts out when they required to be renewed. Holding-down bolts of the common description last from three to five years, but if made of copper or Muntz' metal, they will last as long as the ship. Those holding-down bolts which go through the keelson merely with a notch cut upon the under side of the keelson for the reception of the nut, waste away more quickly than those which go through the ship's bottom. As a general practice the best plan is to make twelve bolts go through the bottom in each engine, four at the crank framing, four at the cylinder, and four at the main centre; and these bolts should be of copper or Muntz' metal, with screws at both ends. The rest of the holding-down bolts should be of iron, and should not go through the keelsons, but be screwed into them, as wood screws, by means of a square neck, and be furnished with a screw and nut above. It is of course necessary that the threads of the bolts screwed into the wood should be wood screw threads, and the bolts themselves should have considerable taper.

Expansion Valves.—Slide expansion valves are, in our opinion, the best, yet they are very little used; probably from the difficulty of obtaining a good combination for altering the degree of expansion; yet such a combination is, we conceive, attainable enough, and there are already several exquisite contrivances of Mr. James Whitelaw's which go far towards the removal of the difficulty. Of the double-beat description of expansion valves, that description is extremely objectionable which has two discs of brass upon one spindle, fitting into the upper and lower valve seats, situated in an upright pipe. Such valves can never be tight except by accident:—if tight when cold, they cannot be tight when hot, for the spindle being surrounded with steam, will expand more than the pipe in which the seats are situated, which has steam only on one side, and which is, moreover, generally of cast iron, the spindle being of brass. The double-beat Cornish valve is the only species of double-beat valve that should ever be employed. Messrs. Fawcett, of Liverpool, have, in some cases, applied a single-beat valve for expansion, with perfect success. It would, of course, be extremely difficult to open this kind of valve, but for the combination of levers, or rather the *principle* of the combination, used in Mr. Watt's original valve gearing; but Messrs. Fawcett have greatly simplified that arrangement, the proper action being produced by means of a single crank.

Heat.—It cannot be doubted that combustion would be rendered much more perfect in steam engine furnaces if the incandescent fuel, instead of being surrounded with water, which, by a rapid absorption of heat, depresses the temperature of the fire, were surrounded by some substance which would prevent the heat from being abstracted by conduction, thereby rendering the heat of the fire the greatest possible under the existing conditions. But it becomes a question whether if by lining the furnaces with fire brick, and thereby preventing the heat from being carried immediately from the furnace into the water, the same amount of beneficial effect would be obtained as by the present practice; and this question resolves itself into the still more abstruse one whether heat is a material substance or a mere property of matter. If heat be a material substance, whatever heat is not given out in the furnace will be given out in the flues, supposing the temperature of the chimney to be uniform; but if it consist in mere vibration, either in the particles of bodies or any etherial fluid pervading them, we may suppose the possibility of those vibrations so counteracting one another as to subside or cease without the production of any adequate effect upon material substances. Sound, it is well known, consists in the vibration of the air; and it is further known that two sounds may conspire to counteract each other's effects, and actually produce silence. Two rays of light, in like manner, may be so managed as to produce darkness; and may we not, in like manner, imagine the possibility of two rays of heat producing absolute cold? It is not impossible that in all furnaces such neutralization may take place, in a greater or less degree; and it is not at all consequential, that by making the combustion more perfect in the manner we have indicated, a greater available heat will be produced. The subject is indeed involved in much uncertainty: it is a very important subject, and we beg leave to recommend its investigation to those who have time and opportunity for experimental researches.

Engine Frames.—We think the adoption of the Grecian or Gothic orders of architecture in the cast iron work of steam engines, is an evidence of bad taste; but the rejection of every species of embellishment is worse still, being indicative of the want of taste altogether. The beauty of a piece of machinery is, in our eyes, a point of no trifling moment; a handsome engine will always be better taken care of and more cleanly kept than one not so distinguished; it will realize a higher price if sold, and need cost little if anything more in the first production. We would not, it is true, sacrifice any useful quality to embellishment, nor would we purchase beauty at any great expense; but we think it extremely desirable that the patterns for the cast iron work of machinery should be so made that, whilst securing the most attainable degree of fitness, they will, without any great additional trouble, confer the additional quality of beauty. We know that there are those who maintain that beauty consists altogether in fitness, and that that object is the most beautiful which possesses every physical property necessary for its intended uses, and nothing more; but this is so preposterous and puerile a heresy that it scarcely merits confutation. A Corinthian column would be quite as fit for supporting its superincumbent weight, if reduced to a mere cylinder of stone; but would it then be as beautiful? The dusky plumage of the sparrow forms as efficient a defence against the weather's inclemencies as the metallic splendour of the humming-bird, and the humblest productions of our looms as effectual habiliments as the gorgeous fabrics of Damascus, or the choicest productions of Cashmere. Fitness is indeed in most things one of the most conspicuous constituents of beauty, but it is one only of a great number, and not always the one which most prominently interests us; and although there are men of such cold imaginations and lethargic sensibilities as to disenable them to perceive beauty in objects except in the ratio of their fitness for a specific purpose, yet such men are only exceptions to the order of nature, and are as surely of a defective constitution as those who are unable to relish the delights of harmony in consequence of the want of a musical ear. The pleasure we derive from the contemplation of the works of Nature is not in many cases due to any sense of fitness. The spectacle of a mountain landscape does not awaken the sentiment of beauty from any specific configuration of the cliffs, or any distribution of the rocks and rivers connected with ideas of fitness, but by virtue of the sympathy with sentient beings associated with the perception of those objects, and which appeals not to the judgment but to the imagination and the heart. The rugged mountain which starts abruptly from the vale—the eternal snows which crown its summit, and pour from their bosom innumerable cascades, and the giant fragments, grey with age, that are strewn about its base—fathomless and impassable ravines, through which the waters foam and wrestle, like an angry and imprisoned maniac—cliffs overhanging and inaccessible, where the eagle reigns in solitary majesty—and echoes which repeat the roar of the cataract and the sighs of the rising tempest—these are all admitted to be beautiful, but it is sympathy alone to which their beauty is attributable, and which gives them life and interest. Without it the sublimest landscape would no more affect us than any casual assortment of colours on a painter's palette.

The ruling appetite of human nature is love of sensation, and nothing is capable of making us feel deeply but the fortunes, past, future, or possible, of man, or at least of some sentient being. Objects do not possess any property *in themselves* capable of exciting the sentiment of beauty, but interest us only by their capability of reflecting emotions associated with them; and that man will relish beauty most strongly and perceive it most readily, whose imagination is most lively and whose social affections are the most fully developed. The beauty of material objects being merely the reflection of emotions pre-existing in the mind, no beauty will be perceived where those emotions do not exist; and those emotions are so nearly akin to benevolence, that a love of beauty is justly held to be symptomatic of an excellent heart, and those whose taste is inanimate or perverted, are, not without reason, suspected to be persons of a low morality, especially in its finer gradations. Good and sensible men cannot regard the quality of beauty as unimportant to any object, and will advocate its creation in all cases where great expense would not be the consequence; and in the frames of steam engines where it may be attained so easily, we think there are few who will advocate its rejection. There is a species of decoration answerable to steam engine frames, or rather an infinitude of kinds, which would confer a high degree of beauty, not by the use of any of the existing architectural orders, which will create associations which must end in disappointment, but a species of embellishment proper to this specific purpose, and such as to be susceptible of adaptation to all the shapes which science indicates as the fittest for resisting the strains to which the framing is subjected.

ON PAINTING TIMBER.

We extract the following observations on painting timber when exposed to damp, by Mr. Lander, from the Professional Papers of the Royal Engineers.

"I beg leave to lay before you a few observations which I have made on the construction and causes of decay in bridges, on the works at Devonport, having been employed on the erection of the bridge at the north-west barrier in the years 1812 and 1813, and also on a large repair in 1837; and I am now employed on a similar repair at the north-east barrier bridge, which, I think, was built in 1816, which has induced me to make the following remarks:—

"1st. These bridges were paved with Guernsey pebbles, which, I think, was one cause of decay, as the wet constantly dripped through the joints; an evil which may be avoided by macadamizing, by which such a compact body is formed that the wet cannot get through, and the joists and girders, &c., are thereby kept perfectly dry, besides the advantage of the vibration being very much reduced, as is the case now at the north-west barrier.

2nd. The whole of the wood-work below, as well as the under side of the flooring, was frequently payed over with coal tar, which, forming a thick body on the surface, was another, if not the greater cause of decay, as it completely prevented the air from acting on the wood, thereby keeping all moisture within, which of itself is sufficient to decay it. It must be observed that the plank or flooring was so rotten, that in many places it would not bear the weight of the men to work on it, and many of the joists and girders broke into two or three pieces in removing them: some of them were found to be quite dry, and in a similar state to snuff.

3rd. As a further proof of the bad effects of paying and paving bridges, I may state that the bridge at the south-east barrier across the old works leading to Stonehouse, the girders, joists, &c. of which have never been payed or painted, and the road above always macadamized, remains sound and good at this time; and I know this to be a much older bridge than either of the former.

4th. I should state that the timber alluded to above is oak, but I think the same observations will apply to other timber, and in other situations, such as fences; for many posts and rails of the stockade fence here have frequently been found decayed, while in other and older fences, although much worn by time, yet not having been payed or painted, the fibre of the wood remains in a healthy state.

5th. I am also of opinion that skirting to walls, and linings to storehouses and other buildings, if not painted, would last much longer, as the damp from behind would then be allowed to evaporate by the action of the external air.

PROFESSIONAL BEQUEST.

Sir—The following information deserves to be more generally known to the public, and particularly to the profession, than I believe it to be; and no way occurs to me more likely to attain that desirable end than the notice of it in your journal, which, as it is especially dedicated to whatever concerns architecture and surveying and their professors, is a very suitable medium for giving it publicity.

By the will of Mr. George Jernegan, of Hatton Garden, himself in the profession, dated the 28th November, 1812, and proved in the Prerogative Court of Canterbury in 1816, the following bequest, *inter alia*, is made, viz., after stating "Ten pounds per annum in perpetuity I present to my two executors, viz., 5*l*. each, for their attendance and trouble, in seeing to the final adjustment of these concerns," the will proceeds "the residue and remainder of interest in the 3 per cent. Reduced Annuities, I wish to go towards the support and comfort of some worthy character bred a surveyor and architect, and in aid of any charity for such a purpose, and this annuity in perpetuity." By the details stated in the will, it would appear the amount of the dividends applicable to this purpose is 10*l*. per annum. The executors appointed in the will were Mr. William Baxter of Clapton, and Mr. George Booth of Bucklersbury.

Doubtless this trust property has hitherto been honourably appropriated; still, as there are no doubt many now living who would be grateful for such aid, and whose cases come within the limited description, it would afford them some satisfaction to know that prior claims alone prevented their participating in the benefit, and I trust such information may be granted them through the medium of this journal. Perhaps also it might be well for the Institute of British Architects to keep a note of the circumstance in their records, for reference on some future occasion of a vacancy: and I trust this bequest may be the nucleus of a much more important provision for those who, in a greater or less degree, may be helpless and destitute.

I am, Sir,
Your very obedient servant,
July 11, 1842. A Constant Reader & Subscriber.

P.S. Allow me to suggest to any of your readers who may possess information of any other similar bequest, that they would be conferring a great benefit by giving it publicity.

REVIEWS.

IRON SHIP-BUILDING.

1. *Iron as a Material for Ship-building.* By John Grantham, C. E. London: Simpkin and Marshall, 1842.

2. *Paper on the same subject, read before the Liverpool Polytechnic Society*, given at page 124 of this volume.

It is rather surprising that it should have been reserved until the present day to apply iron extensively as a material for ship-building. We have been so long acquainted with the capability of metals for floatation, we have availed ourselves of this property so frequently, both in ordinary pursuits, and for many important purposes, that the non-application of it to ship-building appears almost unaccountable. Military men, we should have thought, would long since have had their attention drawn to it, being familiar with the metal pontoon in the erection of temporary bridges. It is from the beginning of this century, however, that we must date our history of the subject, when we find iron boats employed on some of the canals, particularly in Staffordshire. Mr. Grantham's firm seems to have engaged in the construction of these boats as early as thirty years ago. In 1815, a Mr. Jevons, of Liverpool, launched a small iron pleasure boat on the Mersey, which completely answered his expectations. It seems to have been maliciously sunk in the Duke's Dock, where it was subsequently found when the dock was emptied for repairs. In 1817, Mr. Jevons made arrangements with Mr. Horton for establishing a yard at Liverpool for iron ship and boat-building, and in 1818, lodged a caveat in the Patent Office with the view of taking out a patent for an iron life-boat, the model of which was exhibited in the underwriter's room at Liverpool. The death of Mr. Horton frustrated these plans. The iron life-boat appears to have met with the fate of its predecessor, having, after a disappearance for some time, been found in the Mersey with holes drilled in her chambers; she was, however, repaired and sent to the West Indies. In 1820, Mr. Aaron Manby took out a patent for iron steam-boats in France, a measure which appears to have given the first impetus to this branch of metallic industry. A vessel called the *Aaron Manby* was built by the Horsley Company for the Seine, and in 1822, started from London for Havre. She was commanded by the present Sir Charles Napier, K.C.B., who cooperated with Mr. Manby in the enterprise, and from Havre was navigated to Paris, having been perhaps the first and only vessel of any description which ever went direct between the two capitals. Mr. Manby afterwards established ironworks at Charenton near Paris, and built other iron boats, which boats continue in work up to the present time. The next step we have to notice was the construction of an iron steamer for the Shannon, under the direction of the elder Mr. Grantham. Mr. John Laird of Birkenhead afterwards commenced building iron vessels on a large scale, as did Messrs. Fairbairn and Co., and Ditchburn and Mair of London. At a subsequent period Mr. Fairbairn of Manchester undertook a series of experiments at Glasgow in which iron vessels were employed. Subsequently Professor Airy, the Astronomer Royal, undertook the task of ascertaining a mode of correcting the magnetic compass in iron vessels, and providing against the effects of local attraction. Captain Johnston also investigated this subject on the Shannon, and Mr. Grantham at Liverpool. Mr. Holmes, in his pamphlet on steam navigation with the Indies, seems to have been one of the first to advocate the system of iron steamers on a large scale, and although he wrote so late as in 1838, his views then seemed in advance of the day; subsequent experience, however, has gone far to prove their correctness. Two years ago Mr. Creuze, of Portsmouth Dockyard, took up the subject, and was one of the first to treat it practically. We may mention incidentally that the late Mr. Egerton Smith, of Liverpool, took a share at an early period in the advocacy of this, as of so many improvements. Mr. Grantham read a paper on the subject of iron ship-building before the Polytechnic Society of Liverpool, of which he is the President, and this paper has swollen into a goodly treatise now lying before us, and to which we are indebted for the materials on which our present remarks are based. Thus dismissing the literature of the subject, we shall resume its history by reminding our readers of the great progress made of late years. The Government has begun an iron steam navy, the powers of which have been tested and established on the coasts of Syria and China. The East India Company have followed the same example. To the East and West Indies and to South America, iron sailing vessels of a large size have been sent, and have overcome the difficulties and prejudices which were opposed to them. One of the largest of this class is the *John Garrow*, of 711 tons, and we cannot refrain from saying that the owners, Messrs. Anderson, Garrow, and Co., are deserving of a high meed of praise for having steadily and perseveringly prosecuted their exertions under most discouraging circumstances. The *John Garrow*, from bad construction, turned out a heavy sailer, and it became necessary to lengthen her and remodel her lines. The bold attempt of Mr. Brunel in the plan of the *Great Britain* steamer, is one of those events which have fixed public attention, and the issue of which is anxiously regarded. For sea and river navigation, and for towing, the iron steam-boat has shewn very great capabilities, and has established itself on the Thames, the Shannon, the Mersey and the Clyde, on the Seine and the Elbe, on the Nile and the Ganges.

To appreciate the causes which of late years impeded the extension of iron ship-building, we must consider the serious prejudices arrayed against it. It was represented, that however serviceable the iron boat might be on the river, that on the ocean it perilled the life of the mariner, and the property of the owner. It was said that the disturbance of the compass by the mass of the vessel was irremediable, and that the seaman was thus deprived of his greatest safeguard. Beyond this a disposition to drift to leeward, and unsteadiness under the helm, were charges scarcely less formidable. It was said, too, that the speed of the vessel would be impeded by fouling, as the metal surface of the hull became covered with barnacles and weeds. Nay, the vessel itself was held forth as perilous, as liable to corrosion from the sea-water, and consequent destruction of its substance. The stiffness of the hull is another imputed defect, tending to the diminution of the sailing power of the vessel. These serious charges produced their due effect; from whatever cause emanating, whether from the interested suggestions of timber ship-builders, or the spontaneous effusion of timid ignorance, the seaman was alarmed, the ship-owner deterred, and the underwriter raised the premium of insurance. Thus an accumulation of difficulties was created, which the energy, enterprise, and public spirit of those engaged has alone been able to remove, however groundless the charges have turned out to be. The phenomena of magnetism, as connected with iron vessels, are but little known, but it has been established by the experiments of Captain Johnson that an iron-ship becomes a large permanent magnet, having a strong magnetic current in the direction of the ship's length, and causing a serious disturbance to the general polar direction towards which the needle points, and to which it must be made again to turn itself. This Professor Airy has successfully effected, and many long voyages have been made in iron vessels with compasses so corrected. The carelessness of captains of ships has occasionally thwarted this measure, but its soundness has not been impugned. Professor Airy mentions a singular instance with regard to this question. The compasses in an iron ship had been corrected by one of the Messrs. Simms, the mathematical instrument makers, and the ship left the docks in the Thames for Gravesend; at this latter place the Captain stopped and rode up to London in a state of frenzy, having found the action of his compasses most erroneous. The person who had corrected the compass instantly went to Gravesend, and there to his astonishment found that between the time of having corrected the compass and that of the sailing of the vessel, *a large iron stove* had been erected near the binnacle. Professor Airy truly observes:—"This vessel might have been lost on the shoals of the Thames on her first voyage, and not a word would have been heard about the iron stove." In treating of the magnetic action in the compass, Mr. Grantham takes the opportunity of mentioning that an iron vessel is formed of an immense number of plates and bars of different forms, having varying degrees of magnetic force, and the electric currents running in various directions. As a curious question arises as to the period at which the current begins to take a uniform force through the vessel, and neutralising or turning into one channel the multitude of conflicting currents, Mr. Grantham has undertaken to make experiments on the subject. It has been supposed that the course of the magnetic current is determined during the operation of rivetting, or that its intensity is considerably increased, its force being also influenced by the polar direction of the ship's keel while on the stocks, but Mr. Grantham states that he has been led to doubt this. The polarity of the ship, he considers, is not affected by rivetting, but seems to be dependent on the quantity or quality of the iron, and he thence deduces that there is reason to believe that time will have but little effect in increasing or diminishing the magnetic intensity. Captain Johnson, we may add, has observed, that the compass placed a few feet above the deck is not much attracted by the iron, and it is a common practice for the captains of iron ships to place a compass in the cross-trees at the top mast-head, by which to ascertain the correctness of the one placed in the binnacle. Sir Howard Douglas has raised the question whether the changes of climate are likely to affect the intensity of the electric current. We think they might in a slight degree, but experience has proved not to such an extent as to interfere with the safe action of the compass. The long voyages to the East and West Indies, and to South America, have abundantly proved the efficiency of the compass in iron vessels. As to iron vessels being more subject to drift to leeward, and steering ill, as these are circumstances dependent on form, they can be no peculiar defects of iron shipping. The navigable powers of iron vessels, when properly constructed, are as perfect as those of timber vessels; but it is the case that many iron ships being built for a light draught of water, are flat-floored, and very full, without adequate and counteracting depth of keel. This, however, has nothing to do with a deep-sea ship. Fouling in the case of iron ships has been much exaggerated, for it can be entirely got rid of by the application of a scraper, such as Mr. Grantham has invented and described. The corrosion of the iron plates by the action of sea-water proves a groundless alarm—no case of destruction from this cause in many years' experience has yet occurred. Mr. Grantham remarks, that so slight is the apparent decay of the vessel when in use, and so much slower in its progress than is exhibited by iron when applied to other purposes in salt water, that many who have observed the fact, are led to suppose that some occult and preservative law is in operation peculiar to iron so employed. The phenomena of iron rails on a railway will occur to our readers on this occasion, and also those affecting wood pavement. As oxidation is promoted by heat, Mr. Grantham recommends that in steam-boats the boiler should be kept as far as possible from those ports of the vessel which are above water, or means should be adopted to keep them cool by interposing non-conducting substances. The connection of copper pipes with the shell is also to be avoided, and for this purpose the same gentleman states that he has latterly made short lengths of wrought iron pipes, with flanges, and rivetted them to the vessel.* It was assumed that iron vessels would be found unsuitable for warm climates, as subjecting the crew to a greater heat, but neither in the Niger, or the Euphrates, nor in the China Seas, has this proved to be the result. Even at home ship-owners have been deterred from the use of iron by the fear that the public were prejudiced against it, although the experience of the Glasgow and Liverpool steamers, and other large vessels, shows no such unwillingness. We agree with the author before us in regarding stiffness of hull as an advantage and not an injury to the sailing power of a vessel, provided the elasticity of the rigging is sufficiently secured. The prejudice of the underwriters with regard to iron vessels, will most likely turn out very much in the same way as that with regard to chain cables. They would not formerly insure a vessel which had chain cables; then it came to the use of one cable of hemp and another of iron, and now most probably underwriters would object to a ship as insufficiently found if she had no chain cable on board. If the underwriters do not give way with regard to iron ships, the owners and builders have the remedy in their own hands, for it is in contemplation on their part to form a marine insurance company of their own.

Having now disposed of the objections to iron shipping, we shall refer to some of its merits. The first cost is perhaps the feature of primary interest: on this subject Mr. Grantham sums up.

"From a careful consideration of the question of cost, I have arrived at the following conclusions:—

"1st. That a good serviceable iron sailing vessel, not exceeding 300 tons burthen, will be equal in cost to an English-built twelve years timber-built ship, of the same external dimensions, without including the price of copper sheathing for the latter.

"2nd. That iron vessels of above 300 tons have the advantage of being rather less expensive than wooden vessels.

"3rd. That for very large merchant vessels and ships of war, iron will also be found to be much less expensive than wood.

"4th. That iron sea-going steamers bear also about the same proportion according to their different sizes.

"5th. That iron vessels, for rivers, may be built at a light expense, but so built are unfit for sea service."

The prime cost, presenting this immediate advantage, is not the only pecuniary benefit; for iron shipping, from the durability of the material, requires few repairs, and when broken up is more productive than timber. Repairs, the great source of profit to other shipbuilders, can never accrue to the iron ship-builder to an equal extent. The hulls of some of the large Clyde steamers have not cost 1*l.* these five years, while the usual calculation for a timber-built steamer is that the expense of repairs will in ten or twelve years have equalled the first cost. The advantage, in case of breaking up, is in favour of iron as against timber, four to one. Turning to their physical merits, we should premise that malleable iron is one of the strongest materials,* while it may be converted into any shape; on the other hand, timber for curved parts must be grown with great trouble in an unnatural form, or else scarfed, and its strength consequently impaired. The ease, moreover, with which iron beams and frames of any dimensions and in one piece can be wrought, overcomes one of the greatest difficulties in ship-building. As regards the mode of fastening, copper and iron bolts must be used to secure the frames of a timber-built ship, and are so badly contrived that they have little hold, while they are the source of destruction to the ship, as being of a different substance. Mr. Creuze sums up well on this point. He says of iron,

"Among the advantages are the greater durability of the material, not only from its relative durability with that of timber, but from its requiring no such metallic sheathing to protect it from the ravages of worms. Also the greater durability of the structure, as a whole, in consequence of the greater permanency in the perfect combination of its several parts, arising from the fastenings being of the same texture as the portions of materials brought into connexion. The metallic fastenings to a timber-built vessel act, it must be remembered, not only chemically, but also mechanically, to accelerate her destruction so soon as the close connexion of the several parts is at all diminished."

A wood vessel is compared by Mr. Grantham to an arch, being made up of a great number of parts of various forms and sizes, placed in different directions, and being dependent on each other for support. If one becomes loose, the whole structure is more or less endangered. In consequence, a most elaborate system of bracing by iron straps, knees, and bolts with nuts, is now pursued. The bolts do not accord with the materials they fasten together, and the wood is so soft that when a severe strain arises, a general yielding takes place, by the boltheads sinking into it, and the wood itself giving way to the pressure it receives from the neighbouring parts. In the iron vessel, on the other hand, the outer shell of the vessel is composed of a series of plates so rivetted together that its strength is nearly equal to that it would be if formed of one plate. The consequent strength of iron vessels needs little to be said in proof. On the canals the iron boats are put to the severest service, as carrying iron stone, pig iron, and refined iron from the blast furnaces. Mr. Grantham refers to many instances of vessels getting aground and on rocks without injury, and several cases of their being left resting on one or two points of support, without any strain to the framing. A large casting, weighing four tons, is mentioned as having fallen into the hold of the Princess Royal, Glasgow iron steamer, in consequence of the tackle having given way, but without damage to the vessel. Greater capacity for stowage is one of the grand points on which iron shipping claims superiority. Mr. Grantham treats it thus:—

"The shell of a timber-built vessel is so much thicker than that of an iron vessel, that, with the same outside dimensions, the latter is frequently 18 inches wider and 12 inches deeper in the hold than the former. Taking the most favourable part of a vessel—namely, in the centre of the length—in a vessel of 200 tons, the proportion in favour of the iron vessel will be as 5 to 6; but in the ends, which are drawn finely off, the disparity is much increased, making the proportion of the whole contents about as 5 to 4. Supposing, therefore, that a vessel built of timber could stow 200 tons, she would, if made of iron, have room for 250 tons. The total capacities of the largest vessels will probably not approximate nearer than as 5 to 6; making the iron ship of 600 tons not to exceed in outward dimensions the timber one of 500 tons. The advantage of this is very great, and enables an iron vessel to trade, and remunerate the owners, in cases in which a wooden vessel would not return a profit; for, if we suppose that the freight of a 500-ton ship would just pay the expences required to navigate her, an iron vessel would leave the freight on the extra 100 tons as clear profit."

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* On the subject of corrosion of iron, and the means of remedying it, see Mr. Mallett's Papers in this Journal, vol. i, p. 312; and vol. iii, p. 387; Mr. Neilson's Patent, vol. iii, p. 363; and Mr. Wall's, vol. iii, p. 429.

* Vide Mr. Fairbairn on the Strength of Iron, with respect to Ship-building, in our third Vol., p. 388.

"An iron vessel required to carry 250 tons, therefore, equals, in the first cost, a wooden vessel that will carry only 200 tons; and an iron vessel required to carry 600 tons will cost less than a wooden vessel built to carry only 500 tons."

Again, of steamers he says,

"The comparison is much more in favour of iron than with wooden vessels. As the average cargo of a steamer is only, perhaps, about one-third of the load, in engine, cargo and coals together, an increase of one-fourth in her stowage adds 75 per cent. to her capacity for carrying cargo. In other words, to carry a given cargo, the iron steamer may be much less than a wooden one."

Light draught gives the iron ship the monopoly of shallow rivers, and cannot fail to lead to a great extension of navigation. The Indus, chiefly on account of physical difficulties, has hitherto been a closed river; the employment of the new class of vessels must, therefore, create a large traffic on its waters. Cleanliness is a mercantile quality, and is accompanied by health, the nuisances of bilge water and vermin being got rid of in the iron ships. With regard to the latter annoyance, it is related that a colony of rats took possession of the Iron Duke previous to her first voyage, but not relishing the obdurate material of which she was built, a portion of them deserted her at Calcutta, and the remainder immediately on her return to England.

Strength goes a great way to ensure safety in a vessel, and iron plates in strength are, to English oak, as 49·68 to 10·01, or nearly 5 to 1. Iron ships are further to be preferred in this respect as readily admitting the division of the hull by bulkheads. Superior speed Mr. Grantham claims as one of the results to be expected from the extended use of iron. He considers that the cheapness and flexibility of this material will allow of the model of a vessel being made finer, without corresponding loss in the amount of steerage, and in the carrying qualities. In the event of accident, the repairs of iron ships are very trifling, as instanced in the case of the Nemesis war steamer, which ran on one of the Scilly rocks in the British Channel with such violence that, to use the expression of Captain Claxton, "if she had been of wood she would most probably have left her bones on the spot." She was, however, navigated round to Plymouth, and the repairs easily effected for about 30*l.* On the subject of repairs the author so often quoted declares that it is erroneous to assume that iron vessels are more difficult to repair than those of timber, for the injuries are generally external and confined to a single spot, and may in most cases be sufficiently repaired by any ingenious man, if the ship be but provided with a few drills, spare plates, bolts, and other necessary articles, which no captain should neglect to carry among his stores. Besides, he says, when iron vessels become more generally employed, the necessary assistance will be found at all considerable ports and stations at which they may touch. We may add, too, that ultimately the ship's blacksmith will be rated instead of the ship's carpenter, or perhaps in Queen's ships the rating of the armourer raised. In warfare the resistance of the iron sheeting to the impact of shot striking the hull in an oblique direction is an advantage, while even a shot entering the vessel is less injurious than in timber ships, as no splinters are produced—the great cause of death and wounds. Shot holes in iron sheeting admit of being readily stopped, and in an easy manner. The injury from the recoil of heavy artillery, such as is now used, is less on board an iron ship, and enables them to carry a heavier armament.

It is to be regretted that, in their anxiety to secure contracts, iron ship-builders have sometimes been tempted to construct vessels of a less degree of strength than due consideration would have dictated, and have thus endangered the success of the system. Plates of all forms and dimensions have hitherto been used, from $\frac{2}{16}$ to $\frac{3}{4}$ of an inch in thickness, but Mr. Grantham observes that these are by no means the limits within which the plates must of necessity be made; some of much greater strength will, in the farther progress of the art, most probably be put in requisition. Of late, as the size of the vessels has increased, and the extent of the voyages peformed by them, the strength of the plates has been increased. On strength of material it is to be remarked, that oxidation proceeds no faster on the surface of thick plates than of thin plates; so that plates of $\frac{1}{2}$ inch have double the durability of those only $\frac{1}{4}$ inch in thickness. In his remarks on jointing Mr. Grantham decides in favour of the lapped joint in preference to the flush joint, and also in favour of double rivetting. By Mr. Fairbairn's tables read before the British Association at Glasgow, it appears that, assuming the strength of plates to resist tension to be 100

A double rivetted joint will be 70

And a single rivetted joint 56

In the system of flush-jointing, twice the number of rivets are required; and, therefore, to obtain the advantage of double rivetting, four rows of rivets are necessary to each joint.* As to the objection which has been raised to the lapped joints, that they make the hull rough and lessen the sailing powers, Mr. Grantham's defence is that it is very questionable whether the edges, presented in almost straight and parallel lines, can at all impede the vessel's velocity, while they give her a better hold of the water. In reference to an inquiry whether, in case the heads fly off and the rivets fall out, the strength of the vessel is lessened, and a hole left for the admission of water, our author observes that he never heard of such an accident, and that in his yard no occasion has been found to replace a single rivet. Should, however, the head of a rivet break off while the vessel is afloat, it by no means follows that the rivet itself should fall out; on the contrary, when originally secured in a workmanlike manner, the piece remains so firm in the hole as to require the application of a strong sledge to drive it out. Among the errors to be guarded against, Mr. Grantham places that of bolting on a false keel of timber to an iron vessel, by which the *Iron Duke*, a vessel of 350 tons was nearly lost, for having struck heavily on a sandbank, she tore away the false keel, and broke off the bolts by which it was fastened, so that the water entered the holes.

Considered as a national question, and with regard to its capability of extended application, the use of iron in ship-building acquires a great importance. At present the shell merely is of iron, but the decks and bulwarks must ultimately be made of that material. In the shape of chain, iron has been extensively used for cables and for running rigging, for halliards, topsail sheets, &c., in which latter capacity it is found to be superior to hempen cordage as being much more slender than ropes of the same strength, so that it will pass through smaller sheaves or blocks, while it stands better to its work from not being subject in atmospheric changes to any perceptible expansion or contraction. The introduction of wire rope will, under such circumstances, evidently lead to a greater use of iron even for rigging. For masts, iron has also been adopted, and Mr. Grantham mentions one as in use for upwards of twelve years in the Ballinasloe steamer, without sustaining any perceptible loss in its strength. This mast serves also as a ventilator to the cabin. As we stand now with regard to materials for shib-building and rigging, we are dependent on foreign countries, while our builders labour under great disadvantages in competition with their foreign rivals with regard to both timber and hemp, the raw materials of their art. Little timber, be it remembered, is grown in this country, where it is a precarious and little profitable production, subject to the ravages of the worm and of fire, and requiring many years before it brings a return. Neither does it give much employment to labour in its production or subsequent application. Mr. Grantham, on this subject, remarks in a paper read before the late meeting of the British Association at Manchester, that the *Hindostan* timber vessel had cost £72,000, of which about £12,000 was for labour, and £48,000 for wood, and much of this was expended in the East Indies; but an iron ship of £72,000 value would cost £67,000 in labour, all expended in this country, and the remaining £5,000 would also be paid here for the raw material. Were iron substituted for timber and hemp, we should not only give greater employment to labour in our mines, but also in our building yards and to our seamen, for now the inducement is to build ships in those countries where the material is most abundant, while we cannot compete in freight with ships built by several other nations, owing principally to the comparatively low rate at which they can procure the materials for building.

The steam navigation interest is that which has the most to look forward to from the general introduction of iron. At the present day, the machinery and fuel occupy so large a portion of the vessel, that very little room is left for stowage. The weight and tremour of the engines shake and strain wooden vessels and the machinery itself, until the repairs of both swallow up most of the profit which would otherwise be realized. The necessity for a greater degree of adaptation between the vessel and the machinery, is a topic which Mr. Grantham has well handled. The engineer, he complains, is generally very regardless of the requirements of the vessel, and the ship-builder often clings to principles of construction, which, when applied to steamers, are ill suited to the attainment of a high speed. A wooden vessel, when she takes the ground, and frequently when she encounters heavy weather, becomes so much altered in shape that, were the engines so attached as to form part and parcel of the whole, they would be in danger of being broken down, or otherwise injured. Few timber steamers, he adds, can be placed in the graving dock, without first slackening the holding-down bolts of the engines to allow the vessel to spread out, lest the framing should be broken. Were iron vessels general, the case would be different; the engineer might, with perfect safety, firmly unite the vessel and the engine, being the designer of both; and being responsible for the success of the whole, he will not allow one part to suffer for the benefit of the other, but labour to combine both so that they shall mutually support each other. "Then, indeed," says Mr. Grantham, "we may expect to see a perfect steamer."

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* Vide also Mr. Fairbairn on rivetting boiler plates by machinery, at page 351 of our 3rd Vol.

In conclusion, we feel it our duty to say that the public are greatly indebted to Mr. Grantham for having taken up this subject, and treated it with so much ability.

The Theory and Practice of Propelling through Water, with observations on the Comparative Resistance offered by Water to Bodies moving through it at different Velocities, comprising also a Description of an Improved Method of applying Mechanical Power to Steam Navigation. By Henry Booth. London: John Weale.

Mr. Booth is so favourably known to practical men by his past successful exertions in the cause of steam improvement, that any speculations of his, relative to such subjects deserve an attentive consideration, and are almost sure to obtain it. The ultimate object of his present pamphlet appears to be the recommendation of a plan of propelling vessels he has invented, and from which he anticipates far greater efficacy than can be obtained by any modes at present in use; and he seems to found this anticipation partly upon the conviction that the received theory of resistance is erroneous, and he calls upon engineers "not quietly to acquiesce in the appalling theory which ordains that 30 horse power being required to move a given vessel and burthen 5 miles in the hour, 240 horse power will be required to move the same vessel and burthen 10 miles in the hour." Mr. Booth's conviction of the inaccuracy of the received theory of resistance is founded upon the results of certain experiments which he relates, and which, if correctly conducted, certainly present some anomalies not very easily explicable. In experiments with models for ascertaining their resistance when moving in water, he objects to the use of a weight moving at very different velocities as the true representative of the amount of power expended. He says, and his assertion is obviously true, that a weight which descends 10 feet in 3 seconds does not give out as much power as the same weight falling the same distance in 6 seconds, and that at the velocity due to the descent of a body falling freely, no power could possibly be given out; and he supposes that the apparently great increase of resistance to models moving in water at high velocities, is partly due to the diminished efficacy of the weight as a moving power, the velocity of the weight's descent having in many experiments at least been increased with the increased velocity of the model. By making such arrangements in his apparatus that the time occupied by the weight in descending through a given space was always the same, and the velocity of the model varied by the use of larger or smaller drums for coiling up the string, Mr. Booth has obtained results very different from those obtained where the drums remained of the same diameter, and the increase of the velocity of the model was attended by an increased rapidity in the descent of the weight.

There are several circumstances which prevent the results of the experiments from being conclusive in our eyes. The different degrees of the immersion of the models do not appear to have been noted; and the want of uniformity in this respect is an obvious source of fallacy. At high velocities it is well known models and light boats will rise almost out of the water, and their resistance will then be very little; and whether this source of diminution in the resistance may not have existed in these experiments—or to what extent—we are unable from the details before us to assert. Mr. Booth will probably tell us, that the velocities in the cases from which he has drawn his results were equal, and that therefore the effect proper to the diminished immersion of the boat must be equal also. But he must recollect that the boat in the one case travelled a greater distance than in the other, and although it is true that 7 ft. 6 in. of progress in 3 seconds is equivalent to 15 ft. in 6 seconds, yet the rates of progression are different, and the sum of the resistances may consequently be unequal. In other words, if 15 feet be travelled over in 6 seconds, less than half of the 15 feet will be accomplished in the first 3 seconds, and more than half in the last 3 seconds, the velocity being accelerated; and in the cases where the 15 feet were passed over, there may be a diminished resistance in the first part of the motion from its greater slowness, and in the last part of the motion from the diminished immersion of the model.

There are other sources of fallacy to which we cannot now advert, and must content ourselves with saying that we do not think any experiments upon the resistance of bodies moving in water, where the prime mover is a weight susceptible of acceleration in its descent, are in any degree entitled to confidence. Major Beaufoy employed a chain, the links of which were raised successively from the ground by the descending weight, to counteract the tendency to acceleration. Other experimentalists have made use of governors, and other contrivances for the same purpose, and the resistance has been measured by a dynamometer. All the experiments so conducted have been confirmatory of the received theory; and we shall be willing to put equal faith in Mr. Booth's researches so soon as he shall have adopted similarly efficacious means of obviating error, and holds the immersion of his models at the different velocities to be a necessary element of the inquiry.

But it is not upon experiment alone that the received theory rests its pretensions; running water and wind, it is well known, impinge upon stationary objects with a force increasing as the square of the velocity, and the atmospheric resistance to railway trains follows the same law. If water be let into an inclined shoot, the velocity of the water two feet down will be twice what it is at one foot down; and as it is the same quantity of water which runs at twice the velocity, the depth of water in the shoot at the lower level will be only one half of what it is at the upper. Now every particle of water which falls two feet will, by virtue of the fundamental laws of mechanics, have just twice the force as every one of those which have descended one foot; and a particle of water will therefore strike any object at the lower level with just twice the force that it would do at the upper; and all the particles of water in the shoot, if striking against a body, will just give out twice the force at the lower level that they would do at the upper. But at the lower level they occupy only half the depth in the shoot, and therefore impinge upon only half the area; and a doubled force upon half the area is just a quadrupled force upon the whole area, which is the received theory. Mr. Booth says a considerable part of the resistance of ships is made up of friction, and that friction does not vary as the square of the velocity. To this it is only necessary to say that we know so little about friction, that we hold it unwise to draw any analogies from it. Friction, we know, is increased by increasing the rubbing surface, and increased also by diminishing it; it is increased by allowing two pieces of some substances in contact to remain for a few minutes at rest, whilst in other cases no apparent increase takes place, and it is certainly affected by many causes which we cannot hold to be mechanical. Besides, we do not believe that friction forms any considerable part of the opposition experienced by a vessel in moving through the water. The speed of a steam vessel is always increased, at least in smooth water, by increasing her length, and in some cases, as Mr. Booth, in another place asserts, by increasing the breadth; but in both of these cases the friction is increased. Thus much we have found it necessary to say in support of the received theory of the resistance being as the square of the velocity; but whether as the square of the velocity or as any thing else, we do not think it to be at all relevant to the merits of Mr. Booth's propellers. Whatever the resistance may be, it is unchangeably fixed in the nature of things, and has to be overcome by Mr. Booth's propellers, just as much as by any others. Propellers may vary in expending the engine power more or less beneficially, but they cannot alter the resistance of the ship, and we are at a loss to discover the reason of these two questions having been mingled together in Mr. Booth's pamphlet.

The system of propulsion Mr. Booth recommends, may be understood by supposing a double arm upon each side of the ship, extending from the ordinary position of the paddle centre to several feet before the water level, moved backwards and forwards by the engine, and furnished with a plate moveable upon an axis at its lower extremity. This arm consists of an inner and outer portion, between which the plate is situated, and this plate is so hung that upon the advance of the arm the edge is presented to the water, and upon the retrocession of the arm the flat surface of the plate is presented. The plate thus opens and shuts in the frame containing it, something after the fashion of a throttle valve, and there are springs upon each side, to prevent it from opening or shutting with an injurious force. Mr. Booth also intends that his project shall be in active operation during only a small portion of the stroke of the engine, the power given out by the engine during the remaining portion being accumulated by means of fly wheels, to give a speed to the propellers during this short interval of 31¼ miles per hour. The action proper to a row-boat is thus approxmated to, and horses are imitated, who, in pulling a boat, always exhibit the principle of concentration. "Thus nature works, and we only endeavour to imitate Nature in her most successful efforts, by the alternate concentrated operation of the patent propellers."

We confess it appears to us there is much want of judgment and much puerile jargon in all this. If the propeller be moved at 31 miles per hour and the vessel at only 10, every stroke of the propeller will put in motion a column of water of an area equal to the propeller, with a velocity of $31-10=21$ miles per hour; and as this water is moved by the engine, a great part of the engine power is thus uselessly expended. Mr. Booth is probably not aware that by increasing the velocity of the paddle-wheel by reducing the area of the float, and thereby increasing the consumption of steam by the engines, and consequently the power, the velocity of the ship is actually diminished in some cases. Twenty strokes of the engine per minute will thus sometimes be less effectual than 15, though with the same pressure in the cylinder in both cases; and the cause is, the difference between the speed of the paddle and the speed of the ship is then too great, and much of the power of the engine is expended in throwing the water back, instead of forcing the vessel forwards. As to the imitation of the expedients of Nature, we must beg leave to insinuate that Nature is best copied when the means devised are the most answerable to the purposes for which they are intended; and that to copy ducks' feet and horses' legs in works of art, merely because Nature employs such agencies, is to depart from the principle by which Nature operates, in the exact proportion of the fidelity of the imitation.

We are unable to extend our remarks further, and there are many heresies which must, therefore, remain unnoticed. We regret that we have been compelled to be so uniformly censorious, but Mr. Booth can well spare the reputation which the best of such schemes is able to confer, and neither is nor needs to be a mendicant of praise. He will, therefore, we are sure, pardon us for stating our honest conviction, that this is one of the very worst plans of propulsion that has ever solicited the favour of the public.

Transactions of the Royal Institute of British Architects. Vol. I. Part 2. London: Longman and Co., 1842.

"Better late than never." After a gestation of six years (for Part I. of this work bears the date of 1836), and a parturition of we know not how many months since it was advertised as preparing for the press, the representatives of the architects of Great Britain have at length brought forth what they facetiously call *their* Transactions: theirs, it must be presumed, upon some principle of appropriation, since, out of the one hundred and eighty-five pages of which the volume (or half volume) consists, less than thirty are the production of the professional members of the Association by whom it is published. And of this small contingent, by far the greater portion belongs to the late and present honorary secretaries, upon whom it was perhaps incumbent to contribute something *ex officio*—so at least it might be supposed, judging from the easy tooth-pick sort of way, in which one of these gentleman dispatches a subject upon which he might have told us a great deal if he had pleased, and *per contra*, the laborious illustration of an Arnott's stove! undertaken by the other. There remain, therefore, only some half dozen pages, devoted to an investigation of that remarkable arch popularly called the stone beam, in Lincoln Cathedral, which it is possible to consider as a free will offering from any member of the profession, towards promoting the objects which the Institute may have in view in the publication of their proceedings, and for this we are indebted to Mr. Nicholson of Lincoln. It is very certain, as every one knows who knows anything of the proceedings of literary and scientific societies, that a paper may be most interesting and valuable as addressed to a general meeting and accompanied by illustrations, and yet possess neither importance nor novelty to entitle it to permanent record; and yet it seems strange that an interval of six years, during which something supposed to be worth listening to has been read at every meeting of the Institute, should have produced so little which on review should appear worth preserving. It is impossible but that the eminent architects who appear among the members of the Institute, should meet with incidents in the course of their extensive occupations which might suggest valuable communications on practical subjects; but the fact is, that we find the names of none of those professional gentlemen whose means of observation are the most enlarged, either in the body of this volume, or in the list appended to it of nineteen papers read at the ordinary meetings during the session of 1840-41, of which nineteen papers, be it further remarked, eight only, exclusive of two translations, are claimed by the professional members of the Institute.

We say all this in no unkind feeling towards our professional friends. We admire sincerely the spirited endeavours of the Institute to carry out some of the most important objects for which the members professed to embody themselves, and if they have not been supported by all who are interested in their proceedings and who profit by them, the fault is most assuredly not theirs; but if the Institute seek to be recognized by the public as a literary society, they must exhibit a little more energy in the performance of the character they assume. The profession in general may not be such ready writers as some others, yet there are those among them who are sufficiently familiar with the printer's devil; and unless some of them will show a disposition to contribute at least a reasonable quota to their own publication, they can scarcely expect the continuance of that aid from their honorary members, and others not bound to the Institute even by that slender tie by which alone they have been enabled to produce the volume before us. If these gentlemen hold the honour of appearing in the Transactions of the Institute at a discount, we disagree with them. They may go far without finding themselves in better company.

These observations must be understood as totally independent of our opinion of the volume itself, which is one of the most valuable offered to the profession and the public for a long time past. It consists of ten papers or essays, illustrated by numerous engravings and wood-cuts. The first in order is a dissertation "On the mechanical construction of the Vaults of the Middle Ages," and the name of Professor Willis is a sufficient guarantee that it has been treated in the most able manner. The subject of stone vaulting in general is one which has been hitherto much neglected by English writers, and the works of foreigners, beginning with the celebrated treatise of Philibert de l'Orme, published in 1568, have been entirely devoted to the forms of vaulting peculiar to the classical and Italian styles of architecture, and they have exhausted their ingenuity in devising methods to meet all cases of obtaining, from plans and designs, the forms of the individual stones of a building for the use of the mason, and these operations have always formed a regular branch of architectural science in France, under the name of the "coupe des pierres." The necessity of regular laws and systems to the Gothic architects in the construction of their marvellous vaultings is obvious, and much of their practice is probably mixed up with the problems of De l'Orme, who treats his subject as one well known, and claims only the merit of first reducing it to writing; but of their peculiar methods nothing has been transmitted to us.

"It becomes, therefore," says Professor Willis in his introductory pages, "a curious and interesting subject of inquiry to trace, from an examination of the structures themselves, what geometrical methods were really employed in setting out the work, and how the necessity for these methods gradually arose. Independently of the value of such investigations to the history of the science of construction, the knowledge of the methods actually employed would greatly assist us in the imitation of the works of each period. For the forms and proportions of every structure are so entirely dependent upon its construction and derived from it, that unless we thoroughly understand these constructions, and the methods and resources which governed and limited them, we shall never succeed in obtaining the master key to their principles, and instead of *designing* works in the style of any required age, we must content ourselves with merely *copying* them.

"The following paper must be considered as an attempt to sketch out an investigation of this kind, and in offering it to the body of practical men who are assembled in this Institute, I am not without hope that some of them may be induced to collect facts and examples by which this investigation may be carried on and completed. For it will appear, as we proceed, that most of the facts required are of such a nature that they can only be derived from the existing buildings by the aid of scaffolding, minute measurement, and close observation, which it is not often in the power of mere travelling observers to obtain.

"Now professional men are so commonly entrusted with the repairs or restoration of these old structures, that if they would take the opportunity of making the required observations in every case where scaffolds were erected about a building, and if such observations were transmitted to the Institute, a few years would suffice to bring together a body of examples from which general rules might be deduced. It is only by comparing many examples that this can be done, for general rules deduced from single instances are commonly worthless."

The subject thus proposed the author follows out in four sections, devoted to the consideration of—the general construction of the vaults of the middle ages; the curvature of the ribs; the ridge ribs, liernes (or short ribs in decorative vaulting), and bosses; and lastly fan vaulting, upon which so much ignorance has been promulgated, and so much learning expended, both of which are dispelled before Mr. Willis's simple and clear-headed investigation of facts.

The first section begins by pointing out the essential difference between Roman and Gothic vaulting, the latter consisting of a framework of ribs or stone arches, upon which the real vaulting is supported, a mode of construction which the author designates as "rib and pane work." In the early stages of vaulting, during the Norman period, these ribs offered very little geometrical difficulty, but as the number of ribs was increased, a more artificial mode of structure became requisite, and the investigation of the mechanical processes by which the arch stones might be fitted to each other, so as to produce the existing results, occupies the remainder of section 1. Among the diagrams which illustrate this portion of the work are exhibited the working lines left by the masons on the beds of the voussoirs of ancient arches which have been taken down. In section 2, the first point considered is the difficulty of adjusting the curvatures in groined vaults when the springing and elevation of the lateral, transverse, and diagonal arches are on the same level, but the spans different. In circular arches this difficulty is accommodated by stilting them at the imposts, or making the diagonal ribs a segment less than a semicircle. With the introduction of the pointed arch this difficulty was greatly diminished; "but notwithstanding the possibility of making pointed arches of any proportion of height and span with their centres of curvature upon the impost line, it will be found that the old expedient of placing the centres of curvature above or below the impost line, for the better adjustment of these arches, was still retained in pointed architecture until the four-centred arch was brought in. I shall proceed to examine this more at length, since it involves so much of the characteristic appearance of these vaults." This characteristic appearance in original Gothic vaulting arises from the curvature of the ribs, (as Professor Willis makes it evident by numerous examples,) being always arcs of circles, and he comments very justly and severely on the erroneous but common method of projecting the diagonals of Gothic vaults by ordinates, to the utter destruction of the mediæval character of the work—"This is the genuine principle of the Roman and Italian groined vault, but is altogether foreign to the principles of Gothic architecture, in which every rib should spring as a separate and independent arch, and in which the elliptic curves produced by this method are totally at variance with the characteristic forms of the style." This mode of projecting the diagonals was taught by De l'Orme, but he was perfectly aware that it was inapplicable to Gothic vaulting, of which, as a matter of curiosity, he gives a description, making every rib perfectly independent of the rest in its curvature. This stupendous blunder is therefore due to more modern times. Even in genuine Gothic vaulting the effect becomes comparatively vapid after the introduction of the four-centered arch, owing to the regularity with which all the ribs start at the same angle from the impost.

The third section is of great practical utility, and treats of projecting the forms of the stones in decorative vaulting, especially of such as form the converging points of the liernes. The subject is complicated, and not to be made intelligible without reference to the diagrams by which it is copiously illustrated. The liernes in decorative vaulting form a variety of elegant figures about the centre of the vault, of which a star shape is the most common. Hence Professor Willis has given to one class of this description of roof the name of *stellar* vaulting, which very happily expresses its character. The dependance of the designs of these vaults upon geometrical construction is well illustrated, the form sometimes coming out in the solid when its existence would hardly be suspected from a mere view of the plan; and on the other hand being sometimes symmetrically laid down, and disappearing under the effects of the perspective. As vaulting advanced in complexity, a revolution took place in its mechanical construction. This occurred when the compartments of lierne vaulting became so numerous, and consequently so contracted, "that it was found simpler and stronger to work the small portions of panel surface between the branches of the boss stones out of the same block, than to cut them away and drop in the panel afterwards. Then the bosses, from the increasing complication of the patterns, began to approach so close, that it was worth while to take the pains to make them meet, and thus the crowns and ridges of the vaults came also to be built solid. Lastly, the solid construction was extended to the entire vault, and so by gradual degrees the mechanical and decorative construction of the vault, which began by being identical, ended by becoming totally different." This brings us to the subject of section 4—fan vaulting.

We must here again refer to the work and the diagrams, in which is developed the method by which the complicated forms of the stones in these remarkable structures may be accurately modelled. The characteristics of fan vaulting are thus described:—

"The pattern of these vaults is always a kind of tracery of the same class as the perpendicular tracery which at that period occupied the heads of windows or the surfaces of walls, the only difference being that the mullions, instead of being parallel and vertical, are curved, and radiate from an impost. Instead, therefore, of the horizontal transoms of windows, we have level circles intersecting the ribs at nearly equal distances, and intermediate rays or ribs are inserted between the principal ones. The panel spaces into which the surface of the vault is thus divided are furnished with arch heads and foliation, exactly as the similarly produced panels are ornamented in the tracery of windows.

"I have already stated that in the lierne vaults a star pattern is commonly found, which radiates from each impost in the same way as the fans of the present class of vaults. The difference between the star and the fan is, that the star is formed of ribs, which may be and often are of different curvature, and the rays of the star of different length, but so skilfully arranged with regard to their solid effect, that although irregular upon the plan, this irregularity is not offensively perceived in the complete work.

"The fan is, on the other hand, formed of ribs strictly of the same curvature and elevation, and its outline is bounded by a horizontal circular rib instead of the zig-zag line of liernes in the former vaults by which the rays of the star are pointed. The effect of the fan is that of a solid of revolution, upon whose surface panels are sunk; the effect of the star is that of a group of branching ribs. This difference of character is assisted by the mode in which the mouldings are disposed in the two cases. In the older vaults a vertical plane upon the plan line of every lierne or rib divides it into two symmetrical halves; but in the fan vaults the moulded rings and arch heads are all perpendicular to the surface of the vault.

"In fan vaults the quantity of decoration is so much increased, and its parts become so small, that it is no longer practicable to frame the tracery of these vaults on the rib and panel system with liernes and boss stones, and consequently the portions near the crown of the vault, where the decoration is compressed and crowded, are always constructed of jointed masonry. But the branching ribs below the first series of arch heads are still built of long stones filled in with panels, and the *tas de charge* from whence the ribs spring is also laid in level courses as before. There are a few exceptions to this general description; for example, the vault of Henry the Seventh's Chapel, which, however, differs in many other particulars from these fan vaults, and will be separately described. It is entirely constructed of jointed masonry without panels. Also the vault of Islip's Chapel at Westminster is a real fan vault, but without any mixture of rib and panel work."

In illustration of this portion of the subject, the author has described the vaulting of the chapel at the east end of Peterborough Cathedral, the construction of which is identically the same with that of King's College Chapel vault, on a smaller scale, but of very superior execution; that of Henry VII's Chapel; and that of St. George, at Windsor, the latter being not a real fan vault, but "a wagon vault, whose lateral or transverse vaulting cells enter it below its crown." These descriptions are accompanied by three elaborate engravings, exhibiting the construction in the most perfect manner, by isometrical views of the upper surfaces. There are also plans and sections of the same subjects, and of the beautiful lierne vaulting in the cloister at Canterbury.

An appendix adverts to some very striking effects produced by modifications in the forms of the spandrils in the vaults of the cloister at Norwich, upon which it is unnecessary to dwell, as the paper from which it is transferred was read lately, and reported in the *Journal* at the time.*

We hope enough has been said on this admirable essay to recommend it to all who profess the study of our mediæval structures, whether as architects or antiquaries. The information it contains addresses itself to both classes, and if it were for the sake of this paper alone, the volume ought to be in the hands of every one interested in Gothic architecture. We cannot conclude better than in the author's own words, hailing with the most sincere satisfaction the promise which he holds out.

"In conclusion I must beg it to be recollected that I offer this paper as a sketch of an investigation, for the completion of which I request the assistance of the members of the Institute in the collection of facts and examples. I have endeavoured throughout to show from evidence the existence and employment of geometrical methods from a very early period, and have attempted to restore some of these methods. I have also ventured to assert the importance of certain forms and arrangements in imparting character to the buildings in question. The necessary limits of a paper of this kind have prevented me from introducing several topics which may appear to belong to the question in hand. Thus I have said nothing respecting mechanical

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* See p. 98—*Journal* for March, 1842.

[illegible] arrangement. Re: [illegible] Middle Age [illegible]

[illegible] Gothic [illegible] long been a [illegible] subject, [illegible] been treated [illegible] attention of [illegible] "of slight [illegible] chronological [illegible] inserted in the [illegible] the styles of [illegible] that eminent and [illegible] English, as divided [illegible] of each are rapidly [illegible] the illustrations by [illegible] that any representation [illegible] magnificent tower at Ver[illegible] to the volume. The other [illegible] eastern view of the cathe[illegible] small church near Dreux. [illegible] peculiar form of pediment [illegible] Gothic of France, but un[illegible] French architecture of making the [illegible] the whole height of the centre [illegible] producing an excellent effect by [illegible] observes, "reprove a prac[illegible] architecture, of executing great [illegible] on a large one." Summarily as [illegible] will be found a most useful chro[illegible] about to examine the mediæval

[illegible] of foreign Gothic, glanced at in a [illegible] the subject of the next, in which [illegible] "The characteristic interpenetrations [illegible] The fanciful intricacy of parts which [illegible] Gothic, and distinguishes it from [illegible] style, has given rise to the excessive [illegible] surfaces. In English Gothic, examples [illegible] are confined to the interference of adjacent [illegible] even these are not common; but in the [illegible] are introduced and accumulated one upon [illegible] express purpose of showing interpenetrations. "Thus [illegible] different bases may be given to the same shaft, or even two or more different turrets with pinnacles may be placed in an identical position on the plan, and made to interfere and interpenetrate throughout their entire height, from the base upwards, in a manner that defies description, and can only be illustrated by drawings."

We shall, therefore, not attempt to follow the various specimens of interpenetration which are displayed in the diagrams, but merely notice the principal illustration—a doorway in the Cathedral of Nevers, flanked by pinnacles, or rather heaps of pinnacles, the composition of which appears at first sight to set at nought all attempt at developement or classification. Mr. Willis has, however, unravelled this strange tangle of architectural details, and has shewn its complicated effect to be produced by "the co-existence upon the plan of three distinct architectural members, each having its own set of mouldings." These members, which are represented in the plate both combined and separate, are two square shafts with their separate pinnacles, caps, bases, &c., set diagonally, so that the angles of the one pierce through the faces of the other, and these are enveloped in a cylindrical column, round which are twisted spirally four shafts, each with its separate cap and base.

(To be concluded in the next Journal.)

Memoirs of the Literary and Philosophical Society of Manchester, Second series. Vol. VI. London: John Weale.

This Society has long stood eminent for the value of its papers, and the high character of several members for the extent of their literary and scientific attainments; it therefore affords us much pleasure to receive the present volume, which contains 23 papers, several of which are of the utmost value, both to the architect and the engineer. The researches and able experiments of Mr. Fairbairn on the strength and properties of cast iron, are particularly deserving of a careful perusal. This paper contains "a laborious inquiry into the transverse strength of cast iron from various parts of the kingdom, and also an extended investigation into the less cultivated field of their relative values, as regards their adaptation to the arts." From this paper we hope to have an opportunity of giving some extracts, and a more extended notice. There is also another paper by Mr. Fairbairn equally valuable—that on the strength and properties of anthracite cast iron. He first makes some observations on the nature and properties of anthracite used for the melting of iron, in Wales, France, and America; and after detailing several experiments on the strength of iron, he concludes by saying—"I consider the use of anthracite coal rather favourable than otherwise to the manufacture of iron; and provided some well conducted experiments were made to ascertain the requisite proportions of flux and ore to this description of coal, much might be done to improve the quality of the iron, and to bring into useful operation a valuable and important mineral production."

In last month's *Journal* we published Mr. Greg's interesting paper on Sepulchral Monuments; by the same author we have another paper, entitled "Remarks on the Mural Architecture of remote ages." There is a paper containing some observations on Sculpture by Paul Moon James Esq., in which he takes a review of the works of our modern sculptors; and there is also one containing a curious inquiry into the origin of the "Babylonian arrow-headed character," by Mr. James Nasmyth, which may be read by the antiquary with much interest. From the press of other matter, we are precluded from giving a more extended notice of this varied and extended volume, but we shall not omit future opportunities of turning our attention to it again, by giving a few extracts from some of the papers which are connected with the profession.

A Series of Diagrams Published by the Society for the Diffusion of Useful Knowledge. Drawn on Stone by H. Chapman, *and Printed in Colours by* C. F. Cheffins. Part II. London: Chapman and Hall, 1842.

These diagrams not only maintain the high character with which we hailed them on their first appearance, but give an earnest of possessing even more extended utility. In the present number the delineation of the mechanical powers is continued, and is accompanied with the section of a fire engine. We should suggest that the value of the work to students would be increased if each plate were accompanied with descriptive letter-press, explaining the power of the screw, pulley, &c., as applied in the diagrams.

A Treatise on Engineering Fieldwork, and Levelling. By Peter Bruff, C. E., A. Inst. C. E. London: Simpkin and Marshall, 1842.

Students have no cause to complain of the want of books on surveying, but of the *embarras de choix*, for among so many works they must certainly find themselves at a loss. The book before us forms the second part of the second edition of Mr. Bruff's treatise, with many valuable additions and improvements. When it is complete, we shall notice it at some length.

New Cemetery.—We understand that the designs for laying out the new cemetery, on the lands of Bangholm, recently fued from the Governors of George Heriot's Hospital, have been considered by the committee of the cemetery company, who have awarded the first premium to Messrs. Cousin and Gale, architects, Royal Exchange, and the second to Mr. Thomas Taylor, architect, Mackenzie Place—all of this city. There were 17 designs sent for competition, including several from London; it therefore reflects great credit on our resident artists, that their works should have been preferred, all but unanimously, in such a competition; and there could be no favouritism, for the names of the successful competitors only became known after their designs were preferred. That for which the first premium is awarded is in the Gothic style, and includes a chapel wherein the usual services of Episcopalians, at the interment of the dead will be performed when required. —*Edinburgh Observer.*

ANSWER TO THE REVIEW OF MR. HAYDON'S LECTURE ON FRESCO.

Sir—It is impossible not to be gratified by the tone, temper, and kindness evident in your review of my lecture on fresco. There are one or two mistakes as to facts, which are easily corrected, and one or two as to my theories of art, which it is but just you grant me an opportunity of refuting. With these exceptions, the article is so gentlemanly in its feeling, so totally opposite to the scurrility of the greater portion of the daily and Sunday press whenever my name comes under their consideration, that I was pleased and startled.

At one time the whole of the press aided and supported me, and I can only attribute the change to this—that for the last 25 years the students have been brought up to consider me a monster and a rebel; that all students in art form literary connexions in their youth; that the young literary men branch off into reporters, critics, or editors; that they have carried their early impressions with them, and that they consider it a moral duty to drive Haydon out of the art, or off the face of our common mother earth, just or unjust. Be assured, therefore, to meet with *justice* is something so novel, that before beginning my reply, your readers must pardon my allusion to it.

The assertion that my quarrel with the Academy was a school-boy quarrel, and that it originated in some one saying "*Haydon's* pictures to the coal-hole!" is an entire delusion; and the President before the committee of 1836, pale and exasperated, found it anything but a "school-boy affair." But now is not the time to recur to so painful a subject: it will be time enough to return to it when the present noble views of Prince Albert, the Commission, and the Government are baffled, they cannot tell why; when a series of portraits are recommended, as most suitable to British taste, in the Houses of Parliament, instead of historical designs; when fresco is given up, and cartoon drawings become a joke;—*till then*, let the Academy question rest, let the Royal Commission get experience, and let the public patiently wait the unravelling this Gordian knot!

The reviewer says, "I hold high art to consist in the selection of the *best* parts, of the *best* models, and in their *union*." So far from it, that in my lectures I have always held up to ridicule Pliny's assertion that such was the practice of Zeuxis at Crotona, when he painted a Helen for the Crotoniates. The selection of the best model, and rendering the parts defective in harmony with the parts not so, is not selecting different parts from different models, which never can harmonize at all. I have ever held high art to consist in restoring man, woman, child, and animal, to the essential physical perfection of their species, cleared from all consequences of accident and disease, as God first created them, more or less, according to the style, for art is divided into epic, dramatic, and historic, and in the illustration of the epic by the species—man—the instrument of illustration, must be as abstract as the style. Man is *here* supposed to be above the degradation of human emotion, or historic fact. The perfection of his body is an emblem of the supposed perfection of his soul; the one must be as much above human frailty as the other; but in the dramatic, the instrument used will bear some deterioration of form from the high standard of the epic, to suit the individuality of any character which is affected by human passion; whilst in the historic, the agents may and must be disfigured by the localities of individuals known to have possessed such characteristics, however inconsistent they may be with a human form in the abstract. The one arm of Nelson—the little figure of Napoleon—and the hump of Richard, are as essential to the historic, as they would be offensive to the epic. *This* is Haydonism, if you please, and not the mistakes of my reviewer.

My kind reviewer wonders at my rejecting David and the *lower* Greek, and adopting Theseus and the *elder* Greek! and I wonder he classes the two together, in the same thought, the same breath! What? class the principles of vitality, action, repose, flexion, extension, compression, gravitation, flesh, bone, and tendon, the characteristics of the elder *natural* Greek, as visible in the Ilyssus and Theseus, with the systematized deformities and pedantry of the lower *unnatural* Greek? The principles of Phidias (the elder Greek) are the principles of the Creator, and Phidias may be considered without profanation as the representative of the principles of the Creator on earth, as far as conveying the effect of vitality by inert marble, in his imitations of the form and actions of man, can entitle him to the immortality; and, therefore, the perfection of sculpture, as visible in the Elgin marbles, is not inconsistent with the perfection of painting when form is considered, and it may be laid down as an axiom in painting, that when the nature, simplicity, and principles of the Elgin marbles are considered inapplicable to British art, British art will be in a condition of inextricable mannerism of either vulgarity or conceit. The Elgin marbles are not Greek, they are *human*. The reviewer says the Πανκαλον or the Πανταριστον are not sound principles of art. Certainly not, exclusively: they are the *seasoning* of the Πανανανκαιον (the all-essential). Convey the all-essential by the all-beautiful, but not at the expence of the all-essential.

"Another of Mr. Haydon's theories," says he, "is the sovereignty of Greek painters; that not a fragment of their works exists *is no argument against enthusiasm*." This is a sort of insinuation I have all my life suffered from, viz., that my convictions proceed from enthusiasm, and, therefore, have no ground; whereas my enthusiasm has always been the *consequence* and never the *cause* of my conviction.

If the descriptions of Pliny of the mode of Apelles to produce tone by glazing apply to the Venetian school, (which produced tone by glazing,) where is the want of reason in saying Apelles coloured like the Venetians, and must have done so? If Quinctilian says Zeuxis discovered the principles of light and shade, light and shade they must have had; if a bull was painted the head coming out and the tail going back, they must have had foreshortening: so of their expression, composition, and perspective. Of their drawing we are certain, and of their execution by touch there can be no doubt.

The reviewer concludes by ridiculing my principle of adorning the Houses of Parliament, and calls the subjects allegorical! I advise the illustration of "the best Government to regulate without cramping the liberty of man," by a series of historical subjects from the history of the world. Surely the allegory is only in the abstract principle; but the illustration of the horrors of anarchy, democracy, despotism, and revolution, and the blessings of law, justice, and monarchy, by positive historical facts, with statues between each fresco of the great men who have caused the principles to be established, is anything but an insipid allegory without meaning or sense. "Nature we want, and nature we will have," says my friend (for I am sure he is so): then comes the question, what is nature? Queen Elizabeth eating beef-steaks and drinking ale for breakfast, the pathetic murder of the princes in the Tower, and St. Augustine preaching Romanism to the Britons, are all equally nature, but nature under different views. To conclude; the "*cave canem*" is not as to Haydonisms, but as to what will be much more dangerous to fresco and sound design, viz., "The ale and beef-steaks of art," under the pretence of nature.

With every apology,

London, July 3, 1842.

B. R. Haydon.

REMARKS ON THE "DESCRIPTION OF THE PERMANENT WAY OF THE SOUTH-EASTERN RAILWAY."

In this age of discoveries, in this truly *patent* century, the minds of so many men, both theoretical and practical, are engrossed by an ambitious zeal of improving the inventions of their predecessors, and by the wonders of their brains of obtaining the reputation of a Smeaton, a Watt, or a Stephenson, that we must not be astonished to find amidst such a host of competitors some advocating schemes stamped with absurdity. It would really be a useful lesson to some of these ardent aspirants for fame to read the list of patents taken out during the last forty or fifty years: it would serve to cool their temperament to find how few have derived any profit from their inventions. That men imagining themselves possessed of the *bump* of invention (I am not sure whether phrenologists admit of such an organ,)—having neither the advantage of a good theoretical education nor the experience acquired by years of practice—should commit the grossest mistakes, both in principle and mechanical combination, is not astonishing, neither should we wonder that purely practical men should fail in theory, or pure theorists in practice; but when we find men possessed of the greatest talents, of great experience and of good theoretical knowledge, at times advocating principles false alike in the eyes of the practical and theoretical man, it only shows with how much caution we ought to proceed in the path of discovery, and how necessary to the establishment of sound principles it is to have a journal like yours, open to the discussion of subjects connected with engineering. These remarks have suggested themselves to me in reading the "description of the permanent way of the South-eastern Railway," which appeared in your journal for this month. I had previously often heard that Mr. Cubitt, who, as an engineer of great abilities and extensive practice, must ever be regarded as a high authority on engineering subjects, maintained the superiority of the triangular to the rectangular sleeper, but on what principles, previous to reading Mr. Pope's description and the report of the conversation which ensued amongst the members of the C. E. Institution, I could never ascertain. It is clear that their superiority in point of *ultimate* economy cannot be determined until they have been tested by some years' use. With regard to first cost, it appears that the advantage of the triangular sleeper is trifling; indeed, if we had not Mr. Cubitt's word to the contrary, I should have said that it was inferior even in this particular. Any other advantage resulting from the use of the triangular sleeper, I certainly cannot conceive, except that the ballast can be more easily rammed, *in this case* no doubt a very great advantage, as from the form of the sleeper it will evidently require that operation very frequently. I shall, however, quote from the description, and if any of your readers can explain to me the other advantages stated, I shall consider it a great favour:—

"The sleepers are of Baltic fir, and are formed by a square balk being diagonally divided so as to cut out four triangular sleepers, which are laid down with the right angle downwards, which form as much bearing surface as one of twice the cubic contents cut out as half a balk, in the usual manner. The advantages arising from this form in the economy of timber, the facility of packing, and the improved drainage of the ballast in contact with the sleepers, are pointed out, and the apparent disadvantage of the tendency to act as a wedge is combated, by showing that the inclination of a right angle exceeds the limits within which the principle of the wedge obtains."

No doubt a sleeper of this form has as much bearing surface as one of twice the cubic contents cut out as half a balk, but it should also be recollected that any weight passing over such a sleeper will exert a pressure increased in the ratio of the square of two to unity, as can easily be seen by resolving the weight in directions perpendicular to the inclined surfaces of the sleepers; and it must also be noticed that this increased pressure on the ballasting is exerted in the worst direction possible, that is, laterally, where there is nothing to retain the ballast, whereas with the common rectangular sleeper the pressure is vertical, and after the first year the ballasting becomes consolidated, and requires comparatively very little ramming. I think, therefore, that for the first year it may be less expensive to keep a railway laid with triangular sleepers in proper order, but that after the first year the "triangular system" will be found inferior not only in point of expense, but also of solidity and firmness. I should certainly be much pleased to learn from Mr. Pope how "the inclination of a right angle exceeds the limits within which the principle of the wedge obtains." Perhaps Mr. Pope could point out these limits: I am sure your readers would also be highly pleased if Mr. Horne would publish an account of his series of experiments on the strength of timber, for the results are quite extraordinary. If these remarks appear to you worthy of being inserted in your valuable journal, you will oblige me by doing so.

Yours truly,

Dublin, June 10, 1842. J. F.

BOOKMAKERS' DESCRIPTIONS.

Sir—Very much to my dissatisfaction, I find that your Journal has prophesied truly with regard to the "Memorials of Cambridge," for there is nothing that amounts to description at all of Cockerell's new building for the Public Libraries, &c; nor is the view of it as it will appear when completed shown so as to enable one to make out from it what the design really is, the principal front being so exceedingly foreshortened that little more than the projecting parts of the elevation are shown. Owing to the portico being taken quite on its flank, one peculiarity—either oddity or original idea on the part of the architect—is not at all discoverable, namely, that it has a *central* column, consequently no central doorway!—a circumstance in the design so very important as well as unusual that, instead of being concealed, it ought to have been indicated as plainly as possible. At any rate, if concealed in the graphic description of the building, it ought to have been pointed out in the letter-press one; but the latter turns out, just according to your Journal's prediction, to contain no description at all, although the wrapper of each No. of the work promises "descriptive accounts of the buildings." Perhaps this may have been a misprint on the wrapper of the first No., which has unluckily not been rectified; and it surely must have been intended that we should read "with historical *but no* descriptive accounts, &c.

Of the two editorial M.A.'s, one an Esq. the other a Rev., neither, it seems, knows anything whatever of architecture, or is capable of even describing a building; yet surely one of the two should have been chosen for his competency in regard to drawing up the "descriptive accounts." As it is, it certainly would have been better had no promise whatever of the kind been held out to purchasers. Yet even without positive promise to that effect, many would, like myself, naturally expect to find the buildings shown in the plates explained, if not commented upon, in a tolerably full and satisfactory manner, in the letter-press, which is certainly not done here, save in the solitary exception specified by your own reviewer, and which is, therefore, rather an unfortunate one as far the character of the "Memorials" is concerned, because it renders all the more striking the absence of similar explanation and description in the other subjects. For not again describing what has been repeatedly spoken of before by others, and rendered quite familiar to us in consequence of having been treated of in a variety of publications, there may be some excuse; but very far different is the case with regard to what may be called "unedited" buildings. One of these is the "Pitt Press," to which may be applied the writer's own words, who tells us, "We possess but a very obscure and defective account of the early history of printing in our University," for his account of the structure is equally "obscure and defective." All that we gather from it is that the building was designed by Mr. E Blore, that the first stone was laid in Nov. 1831, and that it was opened in April, 1833. To be sure we are favoured with a copy of the inscription on the foundation stone, with the names of the nobs who took a part in the highly important ceremony of placing it, "Totâ inspectante et plaudente academiâ," which last is merely a bit of solemn bounce—a silly white lie, that contradicts itself, because, even if such were the fact, it could not possibly have been recorded upon the stone until after the ceremony. A grosser blunder—a more egregious practical Hibernianism—perhaps was never made; and as Mr. Le Keux's editors had not the *nous* to discover it, they have very innocently shown up that exquisite specimen of University sapience, and swallowed the bull, without making "any bones" of it. As to Mr. Le Keux's own share in the work, I suspect it to be very small indeed, for although his name is attached to the plates as the engraver, none of them seem to have been even touched by him; else, if they really are his work, they manifest a very great falling off from his former excellence.

I remain, &c.

T. W.

ROYAL ACADEMY EXHIBITION.

Sir—Observing a letter in your July number, under this head, containing complaints from *The Architect* of a design, the perspective view of which was forwarded by him from a distant county for the purpose of being submitted to the Council or Hanging Committee for exhibition this year, and which, in due time, was reported as having been admitted, and afterwards did not appear on the walls of the Royal Academy, and having been treated in precisely the same manner myself, I deem it right to mention the fact, in hopes that some of your numerous correspondents may be able to suggest some *reasonable excuse* for such indecision on the part of the Hanging Committee.

When I hear of letters having been written by the officials of the Royal Academy to *some* architects who had sent works "obviously varying from the regulations" laid down by the Council, although "the porters are instructed not to receive any" such, in order that, even after the last of *the two days* "announced in the public papers for the reception" of "works intended for the annual exhibition," they might have an opportunity of complying with those regulations; when I find that upwards of 40 of the works catalogued under the head of Architecture in this year's exhibition bear no relation whatever to that noble art; and, above all, when I find such a *mountain-in-labour-like* title as "No. 1011, Raising the monolithal granite obelisk between Fleet Street and Ludgate Hill, on the morning of June 26, 1833," and then see the *mouse-like* production which the reviewer in the *Gent.'s Mag.* very pithily describes as being the representation of "five labourers, with the aid of a triangle and a pulley, performing the Herculean task of setting this vast obelisk on its pedestal," I confess myself quite at a loss to account for the bad faith kept by the Hanging Committee with your correspondent *The Architect*, and with,

Sir,

Your's, faithfully,

London, July 9. Ego quoque.

Turnpike Roads.—In 1818 there existed in England and Wales paved streets and turnpike-roads to the extent of 19,725 miles, and other public highways 95,104—making altogether 114,829 miles. From the report of the lords of the committee upon turnpike trusts, it appears that in the year 1829 the extent of turnpike-roads in England was 18.224 miles; Wales, 2631 miles; Scotland, 836 miles—making a total of 25,541 miles.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.

LECTURE VII.—ON CURVES OF RAILWAYS.

This lecture was devoted to the consideration of curves upon railways, and Mr. Vignoles pointed out the principles on which should be compared the economy and advantages to be obtained by the adoption of curves, with the inconveniences attending on them; the saving of expense in formation, earthwork, bridging, &c., by curving round natural obstacles; the advantages of attaining a more level line, avoiding interference with valuable property, or approaching towns, mineral or manufacturing establishments, &c., all entering into the former—the practical inconveniences of additional resistance to motion and retardation of velocity to ensure safety being the set-off; and, among other elements, it was stated that the breadth or gauge of the railway affected the calculation. The Professor then showed that along very wide valleys, through champaign countries, and where the grounds undulated, so that the ridges, dividing the water courses, were successively crossed by the railways at right angles to their general direction, the saving by lateral deviation would seldom be material, and consequently, that the curves may be laid out so flat as to be practically equivalent to straight lines—the "*accidens de terrain*," to use a French phrase, being, in such districts, to be overcome by cutting and filling, to the extent justified by the importance of the line and traffic, or by the introduction of undulating gradients, somewhat approximating to the natural surface of the country. But in tracing a line of railway along the sides of hills bounding narrow valleys, particularly where the main valley is broken by lateral rivers, then the economy from curving becomes very great, and the introduction of curves to the greatest possible extent, consistent with safety, is allowable.

Mr. Vignoles then went on to consider the various means employed to obviate the practical inconveniences arising from curves on railways. He began by explaining the peculiar distinction in make between carriage-wheels and axles constructed for running on railways and those for common roads —in the former the wheel being keyed fast to the axle, and both moving round together—in the latter the axle being fixed to the carriage, the wheels only moving round. Many attempts had been made by engineers to give the railway vehicle the advantage which the road carriage had of turning with facility and safety round sharp bends, but in vain, as the wheels always got off the rails laterally, at even moderate velocities; it was only on the old tramroads that the wheels were loose on the axles. Railway wheels being thus fixed to the axles have the tendency to move on a straight line, so that on the occurrence of a curve the effort to continue in motion in the direction of the tangent of that curve creates a certain degree of resistance, as the wheels are only kept upon the rails by the flanges pressing against the inside edge of the outer rail of the curve. The Professor then entered into a number of technical details, which he illustrated to the class by diagrams, explaining why the flange of the wheel had now, by common consent, been placed on the inner side of the periphery of the wheel rather than on the outer side; and also the reason for allowing a certain amount of play, being the difference between the gauge of the rails and the gauge of the wheels, and the manner and cause why the rim of the railway wheel is made somewhat conical—that is, the wheel, instead of being quite cylindrical, is really the frustrum of a cone—stating at the same time, the rule for giving the proper "cone" to the wheel, being dependent on the *minimum* radius of curvature on the line to be travelled over, and the *maximum* velocity. In general, the "cone" was stated to be about one-seventh of the breadth of the rim of the line, giving about one inch for the difference of diameter of the wheels at their inner and outer edge, for, when carriages are passing round a curve, the wheel and axle, being connected, roll together as a rigid body, and require the contrivance of the "play and the cone" to prevent too much lateral friction of the flange, and to get the wheel round the curve without dragging. Mr. Vignoles then showed that on the ordinary railway gauge of 4 ft. 8½ in., and in the 3-feet wheels, the above amount of cone and play would be sufficient to meet a curve of only 200 yards radius, which is greater than any which ought to be laid down on a travelling line for high speeds.

The centrifugal force due to the velocity of the carriage was next to be considered. As before stated, its tendency in moving round a curve is to keep a tangential course; this force may be accurately computed (being dependent on the velocity of motion, weight of the carriage, and the radius of curvature) by well-known formula, whence is deduced the fractional part of the weight of the carriage, representing the centrifugal force. The Professor gave the formula, and worked it out on a supposed velocity of something more than 17 miles per hour, or about 25½ ft. per second, on a curve of 200 yards radius, whence the centrifugal force was found to be 1-30th of the weight of the carriage. Mr. Vignoles quoted the following rules—viz., "multiply the square of the velocity in feet per second by the gauge of the railway, and divide the product by the accelerating force of gravity, multiplied by the radius of curvature in feet," which gave an expression, which, though not the fraction of the weight, was what would do very well for practical and ordinary purposes; it was the height which the outer rail of the way should be elevated, to counteract the centrifugal force, and prevent the wheel flying off at a tangent to the curve. He then stated M. de Pambour's more strictly mathematical, but more complicated, rule for obtaining the same amount of elevation of the outer rail, and showed the table of results calculated by that engineer and by Mr. Wood, of which we only give the extremes, by which it appears that, supposing it safe to encounter so sharp a curve as one of 250 ft. radius, at the rate of 30 miles an hour, the outer rail of the way must be elevated 12 in.; but for a radius of 5000 ft., or nearly a mile, at the rate of 10 miles per hour, the requisite elevation is only 1-16th of an inch. Having elevated the outer rail, the axle of the carriage, resting on the two rails, gets such an inclination as will produce on the load a gravitating force inwards equal to the centrifugal force outwards; and there will neither be any tendency in the carriages to upset or to press the flanges of the wheels against the rails. The rails once laid, if the carriages run slower than the calculated rate, the centrifugal force is overbalanced by gravitation, and the flanges of the wheel press the inside rails; if quicker, the contrary effect takes place, and the flanges press against the outer rails, so that some medium rate of travelling must be fixed on; and, as the slow trains are in general most heavily laden, any increase of friction has a more powerful effect of retardation than will occur to lighter loads moving at greater speed. Mr. Wood, therefore, advises that the outer rail should not be elevated more than will compensate the centrifugal force produced at the slower rates of motion with heavy trains. Mr. Vignoles then forcibly illustrated the practical effects of neglecting these rules.

He then entered on the subject of laying out curves on the ground, by a succession of set-offs at the end of each length of any given measure—the set-off being calculated from the radius of curvature, considering the given measure (say a chain length) as the side of a circumscribing polygon; and, on the large scale, and practically, a number of these sides of a polygon become the segment of a circle. Mr. Vignoles gave a simple approximate rule for finding the set-off from the radius, or the reverse, by "divide the number 792 (the number of inches in a chain) by the radius in chains—the quotient is the set-off per chain in inches." Thus, the set-off per chain for a curve of a mile radius is 9.9, or, in round numbers, 10 inches. When the curve is of less than one mile radius, it is advisable to make the sets-off by half-chains. It was observed incidentally by the Professor, from the same rule, the set-off due to the curvature of the earth was, in round numbers, about eight inches per mile, and hence had arisen formerly some curious engineering mistakes, from supposing that a horizontal line was a tangent to the earth's surface; and, in setting out canals, an inclination of eight inches per mile had more than once been given to the water line, while it was imagined it had been laid out for a dead level. In conclusion, Mr. Vignoles mentioned that some further observations on curves would occupy the next lecture.

LECTURE VIII.—ON CURVES.

In continuation of the subject of curves, Mr. Vignoles explained that in many cases it was impracticable or inconvenient to apply, on particular ground, the approximate rule given in the last lecture, of setting out curves chain by chain, or other short lengths, making each the side of a regular polygon, the set-off being constant. In that method the given length was strictly a secant, and not a tangent, to the curve. Another formula was more generally applicable, and sharp curves on hill sides, through thick woods, had been quickly and accurately set on therefrom. It was this; $\mathit{offsett} = \mathit{radius} - (\mathit{radius} - \mathit{tangent})^{\frac{1}{2}}$; the demonstration of this was given, and illustrated by a diagram. For the field, tables calculated beforehand, for the greatest number of usual curves, should be prepared; but, on the occurrence of any peculiar cases, the calculation could be very readily made, with the help of a pocket table of natural sines. The Professor then recapitulated some of the leading points that had been gone over in detail at the last lecture, observing that on the three principal expedients for counteracting the injurious effects of curves, the usual measurements might be easily remembered—viz., half an inch for the "cone" of the tread of the wheel; one inch as a *maximum* amount of "play" of the wheels between the rails (it being disadvantageous to allow too much play); and one inch for the extreme elevation of the outer rail in laying the way, that being the measure due to a velocity of 25 miles an hour, on a curve of half mile radius. Mr. Vignoles then observed that the "cone" being given to the wheels, on account of the curves, when the line of road was perfectly straight, this conical formation of the tuyere was not required, and the general disadvantage of such a form of wheel, not bearing upon the whole face or upper button of the rail, preponderated. It had, therefore, become customary to incline the rail, to meet the cone of the wheel, and this should always be done, both on straight lines and on curves whose radii are not small. This inclination of the surface of the rail is obtained by casting the receiving chair accordingly on rails; having a continuous bearing on longitudinal sleepers, or bearing direct on cross timbers, without the intervention of chairs, the wood is cut to the requisite angle; or the inclination is sometimes given to the rails in passing through the rolls. Without this precaution of inclining the bearing surface of the rail to meet the cone of the wheel, the edge rapidly wears, and the laminæ of iron peel off in strips, more or less, according to its quality, and there is no more critical test of the perfection of rolled iron rails than the manner in which the button edges go through this ordeal. With the above precautions of "cone," "play," and elevation of the outer rail, the resistances opposed by curves to a single carriage may be considered to be practically annihilated; but when the trains become very long, there must, of necessity, be a considerable lateral action and grinding, from the change of direction of the original drawing force through a number of carriages; but Mr. Vignoles stated that, although no conclusive experiments had been made to show the exact amount of resistance from this cause, his own observations and experience led him to conclude that the degree of curvature on railways might be safely extended further than they have hitherto been laid down on principal lines.

Mr. Vignoles referred to former observations of his, that the public would be better accommodated by more frequent departures of smaller trains, and that with such trains the curves would be of still less importance, adding that it could only be by the introduction of greater curvatures to save expense; and, as he had repeatedly argued for the same reason, by the adoption of steeper gradients, that the benefits of railway communication could be extended through many districts, and to the more distant parts of the country, as on the most economical principles of construction. Mr. Vignoles referred to the report of the Irish Railway Commissioners, and to the works of Mr. Wood, M. de Pambour, Lieut. Lecount, and other writers, for further details on curves, observing, in conclusion of this part of the subject, that where curves are so quick as to require it, especially in crossings, the additional precaution of guard rails becomes expedient.

In adding a few words on the subject of coupling carriages together in a train, the Professor insisted strongly on the draw-boys being always in the centre, and observed that, as a general rule, the connecting links should be screwed up as stiff as possible consistent with the curves of the railway, as otherwise the carriages are apt to swing. He mentioned that the best coupling was that of Mr. Henry Booth, the talented manager of the Liverpool and Manchester Railway from its very first origin. But, as a general form of combining the draw-boys and buffers on a central rod or tube with spiral springs acting solely from the centre, Mr. Vignoles spoke in the strongest terms of the apparatus of Mr. Thomas F. Bergin, the manager of the Dublin and Kingstown Railway, on which line they had been used with advantage for a number of years.

LECTURE IX.—ON TUNNELS.

In proceeding to treat of the subject, which might be termed that of the great works of art, to be introduced in the formation of roads or canals, but particularly of railways, Mr. Vignoles said that it would not be possible in the lecture-room to go into the details of the constructions, but that he must limit himself to general principles. The rules for consideration when such works ought to be adopted were sufficiently simple; for example, to determine where tunnels should be substituted for open cuttings, or viaducts for embankments. The French engineers, who are in general very much better mathematicians than we are, and probably, from that very circumstance, more inclined to be theoretical, are much in the habit of introducing formulæ which, often very useful, are not always readily applied by the practical men of this country. Supposing it to be required to determine at what point on a longitudinal section (for road, railway, or canal,) it is advisable to begin to tunnel, instead of continuing a simple excavation—that is, the point where it becomes as cheap to tunnel as to cut open—for such a case the following formula is given by an eminent French engineer:—Let a = depth of cutting; l = breadth of road, railway, or canal, on the travelling surface; s = depth of bed, of road, or railway, to be first excavated, and afterwards filled with road material or ballast; or depth of canal below the water-line; $\frac{x}{m}$ = slope of excavation; p = price of the cutting per cubic yard. The expense of excavation per yard forward of the sectional area of any cutting will consequently be $a\,p \times p$ $(l \times \frac{x}{m} = x$; and, when this price exceeds the price per lineal yard forward of tunnelling, the latter is cheaper, supposing the given prices to cover all risk and contingencies in each case. But, as circumstances are continually varying, the English engineer so repeatedly finds that he has to modify—and perhaps finally abandon—the general theoretical rule, and fall back on his own experience, and that of the contractor he may be disposed to employ, that, although he may occasionally resort to such a formula as an approximation, he ceases to employ it in practice, and obtains the sectional area of the given cutting in superficial yards, by simple mensuration, and multiplies it by the price. All the complex conditions involved by slips, faults, water, and the numerous incidental occurrences in great works, to occasion unforeseen expenses, render prices uncertain, and prevent any fixed general rule; and it is only when the materials and probable contingencies are perfectly well known, that the element of cost can be safely introduced into the mathematical formula. For dry indurated sands, gravel, sandstone rocks, &c., calculations may be made within probable limits of error; whereas, in many instances where the theoretical rule and general opinion, even of those sufficiently experienced, would recommend tunnelling, it has been tried in vain, abandoned after great expense in contending with water, and recourse had after all to open cutting. The average cost of tunnelling upon the principal railway lines, as actually executed, appears to be about 60*l.* per yard forward, in some instances as much as 100*l.*, especially when driven forward in reckless haste, and in attempting to sink shafts or drive drifts, without due consideration as to the quantities of water in the various strata, or the means of at once grappling with the difficulties of drainage or pumping. With great facilities, favourable material, and not too much hurrying, the same area of tunnel has been driven for so little as 20*l.* per yard forward. In round numbers, and on an average, the sectional area of the ordinary tunnel for a double line of railway, to be worked by locomotive engines, may be called 50 superficial yards when finished, or within the ring of brickwork or masonry, if lining were required; in this latter case, the sectional area of the opening to be excavated may be assumed as about 80 superficial yards. Mr. Vignoles observed that, for future tunnel operations, with the benefit of past errors and experience, by avoiding undue haste in execution, and with sufficient caution and activity, 40*l.* per yard forward for tunnelling may be taken as an average approximate fair price. Now if it were wished to compare this expense of tunnelling with the cost of open cutting, the Professor observed that, from his experience, which had been very considerable, in removing earth in large quantities, he was not disposed to put a less price than that of 1*s.* per cubic yard for removing material for deep excavations, especially when this price is to cover contingencies of slips, &c.; with such a price, then, an open cutting 55 ft. deep, roadway 24 ft. wide, and soil requiring slopes of two horizontal to one perpendicular, would give a sectional area of 800 yards—that is, the expense (in estimate) would be the same as that of tunnelling. But Mr. Vignoles observed that, in addition, the future maintenance of the tunnel should be taken into consideration, as well as whether the material from the cutting could be disposed of with advantage; the nature of the soil, and a variety of other circumstances which he stated, all of which would influence the decision. In soft rock, which would work with facility, and yet stand nearly perpendicular, the depth might be very much greater than 55 ft. before tunnelling would be cheaper. In such cases, a depth of 80 ft. and upwards had been resorted to. In chalk the proper slope to be given, which was very variable, would greatly alter any elements of calculation, while, on the other hand, in forming tunnels through chalk, experience had shown that water was the great enemy, and had entailed enormous expenses. The Professor went into a great many other points for comparing excavations with tunnelling, but they appeared too technical to be satisfactorily explained in a brief abstract such as this.

On Viaducts and Aqueducts.—Mr. Vignoles next proceeded to the consideration of viaducts and aqueducts, into which, he observed, a totally different set of conditions enter, the cost varying from 20*l.* per lineal yard to the price for which no rule could possibly be laid down. Viaducts such as that of which the London and Greenwich Railway wholly consists, may, probably, be executed for 20*l.* to 30*l.* per yard, including the foundations. Of course, the foundation entered materially into the calculation, and where water had to be crossed, largely increased the expense. In some peculiar instances, a large river viaduct, or bridge, has cost as much as 200*l.* per lineal yard. The Professor instanced a viaduct he had built over the river Ribble, at Preston, for the North Union Railway. The length was 300 yards, the height about 45 feet above the water, and the whole mass, including concrete foundations (where the rock was not attained), comprised about 25,000 cubic yards; coffer-dams were used for the piers, and for one abutment. The bridge consisted of five arches, each of 120 feet span, batiring on the face and spandrils from the parapet to the impost course—roadway about 27 feet wide; the total cost, including all contingencies, was £45,000, which is 150*l.* per yard forward, or 36*s.* per cubic yard on the whole solid contents; this might be considered a low price, inasmuch as an ordinary brick bridge, of twenty to thirty feet span only, and with facilities for construction, can seldom be built for less than 20*s.* per cubic yard. Where no water or expensive foundations are to be encountered, and where the spans of the brick or stone arches do not exceed about 60 or 70 feet, 1*s.* per cubic foot on the solid contents of the viaducts may be put as a good covering price. Mr. Vignoles stated that, for such viaducts, about 60*l.* to 70*l.* per lineal yard might probably be taken as the average approximate cost, and the additional expense, from a considerable increase of height, does not become so very great, as it chiefly affects the piers only. The Professor then enlarged much on adopting timber arches, with piers of masonry, for viaducts of large span and great height, and produced a number of drawings of such bridges, some actually constructed, and some only proposed. The heights were from 70 to 130 ft., the *minimum* price being 35*l*., and the *maximum* 80*l*. per lineal yard. He further pointed out that high embankments should be avoided, and timber viaducts substituted, as a mere point of economy, even without taking into consideration the risk and danger of slipping in such great masses of earth. In an embankment only 40 ft. high, an occupation bridge for a farm would often cost nearly £1000; it was, therefore, only in crossing a very narrow valley or ravine, where no bridges under would be called for, and no masonry—except perhaps a culvert of the very smallest dimensions—that very high embankments should be made. Mr. Vignoles alluded to several such, varying from 70 to 90 ft. high, which he had made, and pointed out a terrible failure in one case, although in other instances success had followed. In passing through hilly countries and along mountain sides torn by ravines, the introduction of the timber-top viaduct, with stone piers, to overcome points of great but partial difficulty, was strongly recommended, especially as great additional height of viaduct could be given at small expense, and thus excavations on each side saved.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ACADEMY OF SCIENCES.

May 30.—The reading of papers connected with the *accident on the Versailles Railway* occupied a great portion of this sitting. One of the most interesting was by M. François, an engineer of mines, on the means of preventing the crystallization of iron used in machinery. On the examination of the ruptured axle of the engine, which was the cause of the calamity on the 8th ult., the conclusion come to was, that the rupture had been caused by this crystallization, the iron being of the best quality, and of a volume more than sufficient for the purpose to which it was applied. Similar results on other railways have been ascribed to the same cause; but no person has been successful in the means of preventing the recurrence of accident by an improved mode of manufacturing the iron, and all that could be done in the way of precaution was, not to permit iron axles to remain in use for so long a period as to undergo the crystalline change which is so fatal, and of which external appearances give no indication. M. François informs us, that, in a long continued series of experiments, he has observed that a magnetic action upon iron when in a state of fusion, will produce the change alluded to, causing the small and closely adhering grains to crystallize into coarse and larger grains, depriving it of its compact character; and it is inferred that the action of heat upon axles employed in machines, subjected to great velocity, will produce the same effect. This can only be prevented by diminishing the volume of silicate in the iron, by carefully sweating the coal employed in melting, and above all, by the use, in the manufacture of axles, of iron which has already undergone a partial change in its vitreous character, and which, on being reworked, is much less susceptible of crystalline change than new iron. Another communication on the same subject, by Colonel Aubert, was also read. He agrees with M. François as to the cause of the imperfection complained of, but appears to think that the only real precaution is, to change the axles employed in railway locomotives so frequently as not to give time for them to undergo the crystalline change, which is found to be so destructive. Another paper, by Mr. Manby, on the causes of railway accidents, and the means of preventing them, excited much attention. This engineer recommends the use of four-wheeled locomotives, but with some important modifications in the construction of them, both as regards the axles, so as to expose them to an inferior degree of stress than upon the present system, and the frame-work of the wheels, which should, he says, be within the wheels, and immediately under the boilers. He also lays down some practical rules for counteracting the liability of locomotives to run off the rails, and mentions several facts in support of the correctness of the various portions of his system.

A paper, by M. Pambour, on the means of *checking, or rather equalizing the velocity on railways, by the use of fans*, deriving a force of resistance in the precise proportion of the velocity communicated by the impetus of a train, was next read.

M. Fleurian de Bellevue made a communication *on the deterioration of stone in buildings*, which he ascribes to an emanation of acid gas from the earth. He recommends a series of minute, but apparently almost impracticable, chemical experiments in the way of analysis of this emanation.

A communication was read from M. Agassiz, announcing that the King of Prussia has placed at his disposal a sufficient sum of money for him to test, in the glaciers of Aar, the truth of his theory respecting the *progressive motion of glaciers towards the adjoining valleys*. He is about to pierce an opening downwards from the highest point of the glaciers, and expresses a conviction that the result will prove his theory to be correct.

M. Arago addressed the Academy at some length on the eclipse of the sun, then about to take place.

June 6.—A paper *On the nature of the air which we breathe, under various circumstances*, was read. The author, M. Leblanc, has directed his attention principally to an analysis of the air in rooms, hospitals, &c.,—in fact, in all situations wherever it is vitiated by the congregation of persons. He begins by showing, that the air of an empty room, the doors and windows of which are not closed, is precisely the same as that out of doors. This is, of course, natural; but he states also that he found the same to be the case in the *closed* green-houses of the Jardin des Plantes, a seeming contradiction, which he explains by the absorption by the plants contained in them of the carbonic acid of the air, and the giving out again of this air purified by the plants which had absorbed it. But in one of the wards of the hospital of La Pitié, the doors and windows having been closed, the quantity of carbonic gas—that destructive element to human life—was found to be tripled, as compared with what it was before the room was closed, and, in one of the sleeping-rooms of the Saltpetrière, the quantity of carbonic acid in the morning, the doors and windows having been closed during the night, was eight times greater than in the open air. In the great lecture-room of the Sorbonne, after a lecture of an hour and a half, one per cent. of oxygen had disappeared, and been replaced by one of carbonic acid. The quantity of carbonic acid in one of the écoles d'asile, of Paris, after it had been closed for three hours, whilst the pupils were taking their lessons, was found to be precisely the same as in the experiment at the Saltpetrière. At the Chamber of Deputies, he found the quantity of carbonic acid vary from two to four parts in a thousand. The latter amount approaches the limit at which respiration becomes oppressive and injurious. In the latter portion of M. Leblanc's paper, he gives an account of some experiments with air deteriorated by the burning of charcoal.

INSTITUTION OF CIVIL ENGINEERS.

March 22.—Joshua Field, V.P., in the Chair.

On Water Power.

"*Remarks on Machines recipient of Water Power; more particularly the Turbine of Fourneyron.*" By Professor Gordon (Glasgow).

Notwithstanding the diminished importance of water power since the almost universal application of the steam engine, some situations may still be found, in the mining districts of Cornwall, of Derbyshire, and of Cumberland, the Highlands of Scotland, and generally in the districts comparatively destitute of cheap fuel, where it is desirable to render falls of water available.

The theory of water power, as it now stands, may be announced in general terms thus: "The mechanical effect obtained is equal to that of the moving power employed, minus the half of the *vis viva* which the water loses on entering the machine, and minus the half of the *vis viva* which the water possesses when it quits the machine."

Bernouilli recognized the second cause, and soon after Euler the first. Borda, in his "Mémoire sur les Roues Hydrauliques" in 1767, gave the proposition in precise and general terms; whence he concluded that to produce its total mechanical effect, "the water serving as moving power must be brought on to the wheel with impulse, and quit it without velocity."

This principle being admitted, the circumstances next to be considered are: The height of fall—the supply of water—and the nature of the work to be done.

These positions being laid down, the author proceeds to examine the relative efficiency of water wheels of various constructions.

The undershot wheel acted upon by the velocity of the water when confined in a rectilinear course, or when hung freely in a stream: in the former case the efficiency of the machine is equal to 32 per cent. or nearly one-third; in the latter the ratio is 42 per cent. or about $\frac{2}{5}$ths.

The breast wheel is generally applied to falls of from 4 to 8 ft.; in these the efficiency reaches as high as 60 to 65 per cent. of the mechanical effect of the fall of water. The buckets being filled to two-thirds of their capacity their velocity is seldom less than from 7 to 9 ft. per second.

The consideration of this wheel led Poncelet in 1824-25 to the invention of the "undershot wheel with curved floats," the efficiency of which has been found equal to from 65 to 75 per cent. The velocity of this may be 55 to 60 of that of the effluent water—a velocity equal to that due to nearly the whole height of fall; hence the efficiency becomes "about double that of the ordinary undershot wheel." This wheel has not been much employed in Great Britain, although frequently used in France and Germany.

The overshot wheel is most generally employed in Great Britain for falls beyond 10 ft. in height, and some excellent examples occur for work of every description, from rolling iron to spinning silk. Its efficiency averages 66 per cent. but has risen as high as 82 per cent.

The economical use of water as a moving power varying in particular cases, rendered desirable the discovery of a receiver capable of general application, in all circumstances of height of fall, quantity of water, and amount of work to be done; and after intense study Fourneyron produced the Turbine, the peculiarities of which form the subject of the paper.

The imperfect horizontal water-wheels which have been used for centuries in the mountain districts of central Europe and in the northern Highlands are mentioned; then are noticed the experiments of MM. Tardy and Piobert, and the allusion by Borda to horizontal wheels; then a general description is given of the numerous experiments made up to the year 1825, when M. Burdin constructed wheels in which the water was received at the circumference of a vertical cylinder, descended in conduits, placed in a helical form round the surface of the cylinder, and made its escape at the bottom: the efficiency of these wheels was stated to be 75 per cent., but no exact experiments were ever instituted.

The defects in all the previous machines led to the invention of the Turbine as it is now desigued by M. Fourneyron: its construction may be compared to one of Poncelet's wheels with curved buckets, laid on its side, the water being made to enter from the interior of the wheel, flowing along the buckets, and escaping at the outer circumference; centrifugal force here becomes a substitute for the force of gravity.

The mechanical construction of the Turbine is then given, and its action is thus described. The water when admitted to the reservoir rises to a certain level, exercising a hydrostatic pressure proportional to the height of the column, and on the sluice being raised it escapes with a corresponding velocity in the direction of the tangent to the last element of the guide curves, which is a tangent to the first element of the curved buckets; the water pressing without shock upon the buckets at every point of the inner periphery, causes the wheel to revolve, then passes along the buckets, and escapes at every point of the outer periphery; by which arrangement the size of the machine even for a large expenditure of water is kept within narrow limits.

The advantages of the Turbines are stated to be—

1st. That they are with like advantage applicable to every height of fall, expending quantities of water proportional to the square root of the fall, their angular velocities being likewise proportional to these square roots.

2nd. That their net efficiency is from 70 to 75 per cent.

3rd. That they may work at velocities much above or below that corresponding to the maximum of useful effect, the useful effect varying very little from the maximum nevertheless, and—

4th. They work at considerable depths under water, the relation of the useful effect produced to the total mechanical effect expended not being thereby notably diminished.

These advantages are stated to have been realized in the extensive practice of M. Fourneyron, of M. Brendel in Saxony, and of Herr Carliczeck in Silesia, as well as other engineers.

A comparison of the theory and practice of the construction is then instituted, and the following conclusion is drawn:—That if one Turbine has been constructed which works well under a known fall, expending a volume of water exactly measured, this Turbine would serve as a type for all others.

Knowing the fall ane the volume of water to be expended, the Turbine would be made similar to its type. Its linear dimensions would be those of the type, directly as the square roots of the volume of water, and inversely as the fourth roots of the heights of fall. Its angular velocity would be to that of the type, directly as the fourth roots of the cubes of the heights of fall, and inversely as the square roots of the volumes of water. These pracical rules were first made manifest by M. Combe of the Ecole des Mines.

A general review is then given of most of the Turbines erected by M. Fourneyron at Pont sur l'Ognon, at Fraisans, at Niederbronne, and at Inval, upon which last were tried the experiments which completely established the reputation of the Turbine as an applicable machine. The details of these experiments are given, whence the mean results appear to be, that the height of fall being 6 ft. 6 in.—

With an expenditure of 35 cubic ft. of water per second, the efficiency was— = 0·71
" 63 " = 0·75
" 79 " (for which it was constructed) = 0·87
" 126 " = 0·81
" 144 " = 0·80

These experiments were tried by the application of Prony's Brake Dynamometer, to the vertical shaft of the Turbine itself.

M. Arago's proposition for employing the power of one branch of the river Seine upon Turbines, to replace the wheels at the Pont Nôtre Dame, thus giving about 2000 horse power for supplying Paris with water, is then mentioned, as also the results of experiments with very low falls; showing that

With a fall of 3 ft. 9 in. the efficiency of the Turbine was = 0·71
" 2 ft. " = 0·64
" 10 in. " = 0·38

The Turbines of Mülbach and Moussay are mentioned, as are the failures of several of these machines constructed by other engineers, and the paper concludes with an account of a Turbine at St. Blazeux in the Black Forest, where the height of the fall is 345 ft., the quantity of water 1 cubic foot per second, and the reported efficiency from 80 to 85 per cent.*

Remarks.—Mr. Taylor said that Professor Gordon's Paper on the Turbine had been brought before the Institution with the advantages of illustration afforded by the model made under the superintendence of Mr. Jordan for the Museum of Economic Geology; a most useful institution, for the present advanced state of which the country is in a great degree indebted to the zeal and scientific knowledge of Mr. De la Bèche, who conducts the geological survey of the kingdom ordered by the Board of Ordnance.

The Institution was indebted to the courtesy of Mr. De la Bèche for the exhibition of the model, and Mr. Taylor had been anxious that the subject should be brought forward at this time, as the only period at which such a permission could have been granted; for models once deposited in the museum were not allowed to be removed. But it had been arrested in its passage from the hands of its maker, and thus had been procured for the inspection of members of the Institution.

Mr. Taylor then proceeded to remark, that, although the improvements in the application of steam had rendered water power of less value than formerly, yet there were many situations, particularly in the mining and highland districts, where it was still employed beneficially. And as an instance of the extent to which water power might be applied, he mentioned a case in Devonshire, where in the adjoining mines of Wheal Betsey and Wheal Friendship, near Tavistock, which have for many years been under his management, a fall of water of 526 ft. in height is employed in giving motion to seventeen overshot wheels, eight of them performing the duties of pumping water from a depth of nearly 200 fathoms. The diameter of the largest of these wheels being 51 ft. with a width of breast of 10 ft. clear within the rings, the smallest of the eight being 32 ft. diameter, and the others of intermediate sizes.

Four other wheels give motion to machines for drawing up the ores to the surface, their diameters varying from 40 to 26 ft.; and the five remaining wheels are employed for mills for crushing and stamping the ores. In addition to all this power, a steam-engine with a cylinder of 80 in. diameter, and 10 ft. stroke, is provided as an auxiliary in periods of drought or frost.

He then gave the distribution of this water power in the following tabular form:—

Overshot Water Wheels employed in pumping water at Wheal Friendship Lead and Copper Mines, near Tavistock, in July, 1841. From data furnished by Mr. Anthony Rouse, engineer at those mines.

All the wheels operate on their pumps by means of a simple crank formed on each end of the centre axis or gudgeon, on which the wheel is mounted. Two long rods extend nearly in a horizontal direction, from the pins of those cranks, to the upright arms of two bell-crank or elbow levers, which are situated at the mouth of the pit, or shaft, and from the horizontal arms of those elbow levers, two vertical pump-rods are suspended, in the pit. Those rods and the pump-work are the same as commonly used for steam engines in Cornwall, with plunger pumps, except that there are two pump-rods in each pit, and they move up and down in contrary directions, owing to the two cranks on the ends of the axis of the water-wheel being bended in opposite directions; by that arrangement the weight of the two rods counterbalance one another; one half of the pumps are connected to one rod, and the other half to the other rod, and the water is raised in the pumps by turns. All the wheels have a considerable length of horizontal rods, to extend from their cranks to the elbow or bell-crank levers at the pit's mouth; and in some cases a very considerable length of such rods, occasioning much friction.

1. *Old Sump Wheel*, 51 feet in diameter, 10 feet broad. The water poured into its buckets was at the rate of 5632 gallons per minute; which, at 10 lb. per gallon, would be 56,320 lb. weight, descending 51 feet = 2,872,320 lb. per minute descending 1 foot; that is, the power of the water expended; or being divided by 33,000 lb. (for a horse power according to Mr. Watt) gives 87·0 horse power expended.

The wheel when so supplied made 5 revolutions per minute, and worked 6 pumps, as follows:—

Lifts.	Fath. Feet.	Diam.	Weight.
			lb.
1	43 1⅔	13½	16,136
3	112 3⅓	13	38,922
1	25 3	14	10,225
1	6 5	9	1,132
			66,415

The length of stroke in the pumps was 6 feet; and the effective motion in the pumps to raise water, was at the rate of 30 feet per minute.

The weight of the columns of water in all the 6 pumps, amounted to 66,415 lb. weight, which being raised 30 feet per minute = 1,992,450 lb. per minute raised 1 foot; that is, the power realized or exerted in actually raising the water; or being divided by 33,000 gives 60·36 horse power realized.

Wherefore an expenditure of water power equal to 2,872,320 lb. per minute descending 1 foot (or 87·0 H.P.) produced a useful effect realized in water raised by the pumps, equal to 1,992,450 lb. per minute raised 1 foot (or 60·36 H.P.); the useful effect or work done being at the rate of 69·4 per cent. of the power expended, the remaining 30·6 per cent. being lost, partly by friction of the pump-work, and resistance to the motion of the water through the pumps, and partly by imperfect application of the water to the wheel.

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* The discussion upon Professor Gordon's, and Professor Moseley's Papers extended over several evenings, but are all recorded together for the sake of acility of reference.

II. *Taylor's North Wheel*, 50 feet diameter, 6⅓ feet broad; was supplied with 5199 gallons of water per minute=78·75 H.P. expended. It made 5 revolutions per minute, and worked 6 pumps with a stroke of 6 feet; weight of the columns of water in those pumps 44,689 lbs., which was raised 30 ft. per minute=40·63 H.P. realized; being 51·6 per cent. of the power expended.

III. *Taylor's South Wheel*, 40 feet diam. 4½ feet broad; supplied with 4167·4 gallons=50·5 H.P. expended. It worked 2 pumps, 6 feet stroke, 5 strokes per minute; weight of columns 30·270 lb.=27·53 H.P. realized; being 54·5 per cent.

IV. *Brenton's Wheel*, 32 feet diam. 7½ feet broad; supplied with 8897·4 gallons=86·3 H.P. expended. It worked 5 pumps, 6 feet stroke, 4½ strokes per minute; weight of column 30·092 lb.=24·63 H.P. realized; being only 28·5 per cent. of the power expended, which is to be accounted for by the additional friction of a great length of horizontal rods by which this wheel works its pumps.

OVERSHOT WATER WHEELS AT WHEAL BETSY MINES, IN JULY, 1841.

I. *Job's Wheel*, 42 feet diam., supplied with 2890 gallons of water per minute=36·78 H.P. expended. It made 4 revolutions per minute. Weight of the columns of water in the pumps 28·314 lb. 6 feet stroke=20·6 H.P. realized; being 56 per cent.

II. *Williams's Wheel*, 40 feet diam.; 3027 gallons per minute=36·68 H.P. expended. It made 4⅓ revolutions. Weight of columns 26·454 lb.; 7⅓ feet stroke=26·45 H.P. realized; being 72·1 per cent.

III. *Buller's Wheel*, 40 feet diam., 1912 gallons=23·17 H.P. expended. It made 3 revolutions. Weight of columns 22·901 lb. 7½ feet stroke=15·61 H.P. realized; being 67·4 per cent.

IV. *Carpenter's Wheel*, 44 feet diam., 1985 gallons=26·46 H.P. expended. It made 4½ revolutions. Weight of columns 18·662 lb., 6 feet stroke=15·26 H.P. realized; being 57·6 per cent.

Conclusion.—If Brenton's Wheel at Wheal Friendship is rejected, as an extreme case, the average performance of the other three wheels at Wheal Friendship will be 58·5 per cent.; and of the four wheels at Wheal Betsy 63·3 per cent. Or the average performance of all the seven wheels will be 61·2 per cent.

Wheal Friendship.	Old Sump	69·4	58·5 per cent.
	Taylor's North	51·6	
	Taylor's South	54·5	
Wheal Betsy.	Job's	56·0	63·3 per cent.
	Williams's	72·1	
	Buller's	67·4	
	Carpenter's	57·6	

Mr. Jordan described the turbine to consist of three principal parts:—

1st. A cylinder with a base upon which are fixed the guide curves, directing the water at a certain angle upon the buckets of the moving ring.

2nd. A sluice regulating the flow of water from the bottom of the cylinder upon the buckets, and

3rd. The external or revolving ring with its buckets, and its upright shaft whence the motion is communicated to the machinery to be driven.

The buckets are confined between two annular plates, the lower one being attached to the vertical shaft, in the bottom of which is fitted a hardened steel thimble, into which a pivot of "glass-hard steel" works; this inversion of the ordinary arrangement of the pivot, is to prevent any particles of sand or other substances from getting upon the point, and producing friction. Oil is introduced to this pivot by a tube connected with a small pump, worked by the machinery at the requisite speed to keep it lubricated.

The form of the buckets is a mathematical curve, and on the perfection with which this is traced, will depend the efficiency of the turbine.

These parts are enclosed within a cylinder, so arranged that it shall serve as the reservoir, whence the water is admitted upon the moving parts by the sluice, which must be well fitted to prevent a loss of water, and is uniformly raised or lowered by gearing placed on the top of the cylinder. When the height of the fall is considerable, the cylinder is closely covered, and the moving shaft passes through a stuffing box in the centre, but with low falls the cylinder is open at the top.

A great advantage in the machine is, that the castings and iron work composing it, are (with the exception of the buckets) very simple, they require little adjustment, and only a few parts are turned or bored, so that the construction ought to be economical.

Mr. Rennie had endeavoured to introduce the turbine into notice some years ago, and the nature of the curves had been examined in an article in Herapath's Magazine. Professor Gordon's statement corresponded very nearly with what he had heard from MM. Fourneyron, Arago and Morin, and subsequently seen of these machines when in France. He had visited a turbine erected by a Mr. Isterwood at a flour-mill at St. Maur, near Paris; the machine drove ten pairs of millstones 3 feet 4 inches in diameter, at the rate of 200 revolutions per minute, equalling 40 H.P.; subsequently three additional turbines were erected for the purpose of driving ten pairs of stones each, or in all forty pairs of stones by four machines; each turbine had a diameter of 5 ft. 2 in. and a depth of bucket of 8 inches, with a fall of water of about 6 ft.: when entirely submerged to the depth of 4 feet, the turbine continued to make (as in low water) 50 revolutions per minute. Subsequently, in September 1840, he visited the flour mills of M. D'Arblay at Corbeil. These mills are four in number arranged in a quadrangular form; each mill contains ten pairs of millstones, which were originally driven by four well-proportioned cast iron wheels of about 18 ft. diameter; two out of the four wheels were still at work, but the other two had been replaced by two turbines similar in dimensions to those at St. Maur. One of them was working ten pairs of stones. The motion was communicated to a horizontal shaft by means of bevil wheels, one fixed on the upper extremity of the upright spindle of the turbine, the other of smaller diameter fixed on the end of the horizontal shaft, on which also were fixed the riggers for driving, by means of straps, smaller riggers fixed on the millstone spindles. The work was very regularly done, and the proprietors expressed great satisfaction. The second turbine was then erecting, and the third and fourth water-wheels were to be replaced by similar machines. No fault was attributed to the original wheels, but their effect was not equal to that of the turbines. The maker (Mr. Isterwood) stated that he had made these machines entirely under the direction of M. Fourneyron, who alone knew how to trace the directing and emissive curves, and that unless they were properly described, the effect would be greatly reduced. He at the same time stated as his opinion, that there was no economy in the construction of the turbine over the common water-wheel, as the former is more complicated and costly. M. Fourneyron seemed to doubt whether any other machinist than himself could construct a turbine properly; the principal difficulty being in tracing the curves, which had been the study of his life; he quoted several instances of failure when strangers had attempted their construction. M. Arago and M. Poncelet were of the same opinion; the former stated that the effect of the curves was contrary to theory. M. Morin expressed his confidence in the accuracy of the experiment made with the *frène* or friction brake of Prony applied to the axes of the turbines.

Mr. Rennie had seen a cast iron water-wheel with close buckets very nicely balanced, 24 ft. diameter and 5 ft. 6 in. wide, made under the direction of his father, realize 80 per cent. of effective power, and Professor Gordon in the paper spoke of 82 per cent. for an overshot water-wheel. He did not however by these observations mean to disparage the turbine, with which the mechanical world generally was not sufficiently acquainted.

Mr. Taylor thought that Mr. Rennie had overlooked the two prominent advantages of the turbine, in comparing it with other methods of employing water power.

1st. That of its being equally adapted for very low or for very high falls; in falls under 10 feet the breast-wheel afforded but an imperfect mode of using the power, as the actual efficiency fell far below what ought to be obtained by a more perfect machine; and in falls above 50 or 60 feet, if overshot wheels were used, a number of them must be constructed with the disadvantnge of increased expense and probable inconvenience in their application. Instances had been adduced of turbines working with a fall as low as 2 feet and as high as 345 feet; the efficiency of the former being stated at 64 per cent. and of the latter from 80 to 85 per cent.

2nd. That they are not affected by back or tail water like almost all other hydraulic machines; it having been shown, by direct experiment, that when working at considerable depths under water, the relative proportion of useful effect produced, to the total mechanical effect expended, is not thereby notably diminished. This in his opinion was one of the most important advantages of the turbine.

For high falls, the water-pressure engine and Barker's mill, as improved by Whitelaw and Stirratt, rivalled the turbine; and for low falls there were many machines which were very effective; for instance the balance-engine, and the old "flap-jack," with a reservoir of water at one end of a beam and a pump at the other; he had seen such a machine working with a ten-foot stroke, pumping from a depth of 200 fathoms: but for falls subject to great fluctuation, none of these machines appeared to equal the accounts given of the turbine.

Mr. Farey had not collected from the paper, or the discussion, how the quantity of water passing through the turbine had been measured. The power exerted appeared to have been tried by a break applied directly to the axis of the turbine, whereas ordinary water-wheels are usually tried by the work which they actually do perform, and that by the intervention of machinery which causes a considerable loss of power by friction. In order to make a fair comparison, the two kinds of machines should have been experimented upon exactly in the same manner, which did not appear to have been done.

When Mr. John Taylor stated, that the effect of the best of the large water-wheels used for pumping water out of the mines under his management, had been calculated to be 69 per cent. of the power expended; it would be found that the effect produced had been computed by the weight of the columns of water in the pumps, multiplied by the height through which such weight was raised; such being the usual mode of reckoning. But it is obvious, that much more power was exerted by the water-wheel than would thereby be brought to account in the 69 per cent., owing to the friction of the pit-work and pumps by which the water was raised. The turbines appear to have been tried in a way which would not incur much of that loss, but which would bring to account in the per-centage nearly all the power which, in practical operations, must be lost by the friction of the machinery with which a water-wheel or a turbine must of necessity be connected, in order to perform such operations.

PROFESSOR MOSELEY'S CONSTANT INDICATOR.

"*Results of a Trial of the Constant Indicator upon the Cornish Engine at the East London Water-works.*" By Professor Moseley, F.R.S., &c.

The object of this communication is to exhibit and explain the results given by the author's Indicator during a continuous registration from the 28th January to the 25th February, 1842, the engine during that time making 232,617 strokes. The numbers registered by the counter of the engine and the Indicator were noted each morning and evening, and are recorded in a table appended to the paper. The differences between each two consecutive numbers registered by the counter, giving the number of strokes made between each two observations, are contained in one column of the table, and in another column are the differences between the successive registrations of the Indicator. These are followed by the mean registrations of the Indicator at every stroke of the engine, being the quotients of the numbers in the last-named column divided by the corresponding numbers of the preceding column. The paper, after thus stating the numbers registered daily by the Indicator during the period of trial, proceeds to explain the formula to which they are to be applied, in order to determine the work done daily by the engine. The formula, when reduced from the general one by the introduction of the numerical values of the constant dependant upon this engine, is

$$U = 161{\cdot}4474\ N - {\cdot}09051\ L.$$

In this expression, U represents the units of work (in lb. raised one foot high,) done upon each square inch of the piston through any given time, during which the number registered by the Indicator is represented by N, and the space in feet which the piston traverses, by L. The second term of the formula, which is very small as compared with the first, is a correction for the influence of the friction of the Indicator on the number registered by it. The formula being then reduced by the substitution in it of the numerical values before alluded to, the whole number of units of work per square inch of the piston done between the 28th January and the 25th February is shown to have been 21,464,067·1727. From this is deduced the work done during the same time upon the whole area of the piston as well as the duty done upon the piston for each cwt. of coals. These calculations are followed by a comparison of the results given by the Indicator with those previously obtained from actual experiment by Mr. Wicksteed; whence it appears, that with a necessary allowance for a difference in the lengths of stroke at the periods of the two experiments the results of the two are almost coincident. The work per stroke upon every square inch of the piston as obtained by experiment is 120·574, whilst as shown by the Indicator it is 119·338 lb.

Professor Moseley exhibited the Indicator, and described its construction and action;* the accompanying engraving (Plate XI.) represents the Indicator constructed by the committee. C and D are cylinders, each four inches in length, communicating by the steam steam-pipes A and B with the top and bottom of the cylinder of the engine to which the Indicator is applied, and well clothed with felt to prevent radiation. In these cylinders work two solid pistons, each four square inches in area, fixed upon the extremities of the same piston-rod E F, which piston-rod (when the steam passages A and B are open and the Indicator is in action) sustains in the direction of its length a pressure equal to the difference between the pressures upon the two pistons fixed upon its extremities, or (since these sustain the same pressure with equal portions of the opposite sides of the piston of the engine) equal to the *effective* pressure of the steam on four square inches of the piston of the engine. This pressure upon the piston-rod is made to bear, by means of a shoulder Z, upon the steel spring S T, which spring is connected by means of links at its extremities with a second similar and equal spring Q R, supported at its centre upon a solid projection P, from the cast-iron frame of the instrument. The pressure of the piston-rod upon the lower spring borne at the extremities of the upper spring, whose centre is fixed, is thus made to separate the two springs from one another, and the separation produced is, by a well-known law of deflection, directly proportional to the pressure sustained, so long as the deflections are small. The limits within which this law of deflection obtains, are greatly extended by the peculiar form given to these springs, first suggested (it is believed) by M. Morin. One surface of each spring is plane, and the opposite surface of that well-known parabolic form by which an equal *strength* is given to every portion of the length of the spring. The spring being thus tapered from its centre to its extremities without impairing its strength, its deflection is distributed more uniformly throughout its length, and being thus made less (for a given separation of the springs) at every point, the elastic limits are nowhere so soon passed.

By this connection of the piston-rod with the springs, its position is made to vary directly as the effective pressure upon its extremities, or as the effective pressure upon four square inches of the piston of the engine, so that every additional pound in that pressure will cause the piston-rod to alter its position by the same additional distance in the direction of its length.

The pulley or wheel I K (which, from the peculiar functions assigned to it in this machine, we propose to call the *integrating* wheel,) turns upon the piston-rod as its axis, and traverses with it at the same time in the direction of its length, being prevented from moving on it in that direction by means of two shoulders fixed by adjustment screws.

The arms of this wheel are pierced by apertures, through which pass three rods united at their extremities (as shown in the figure,) so as to form the rigid frame G H, which frame turns also upon the piston-rod as its axis, but does not traverse with it in the direction of its length; so that the wheel I K is made by its motion with the piston-rod to traverse the rods of the frame longitudinally, whilst it is made to sweep the frame round with it by any motion of rotation which may at the same time be communicated to it about its axis. It receives such a motion of rotation from the cone K L, which is so placed that its side may be accurately parallel to the piston-rod, and which is kept continually pressed against the wheel at K by means of a spiral spring inclosed in a tube at M, and acting continually against the extremity of the spindle on which the cone turns.

A system of bevel wheels U, Y, X, communicates to this spindle, and with it to the cone, the rotation of the pulley N, which pulley is driven by a cord carrying a weight at one extremity, and passing by the other extremity (over directing pulleys) to the piston of the engine, or to some point which moves *precisely as the piston of the engine does, but through a less space.* The circumference of the pulley N being thus made to move precisely as the piston of the engine, the angle described by the cone, during any exceedingly small period of time, is made to be exactly proportional to the space described during that time by the piston of the engine. Now let it be observed, that the circumference of the integrating wheel I K partaking of the motion of that portion of the surface of the cone with which it is at any instant in contact, the number of revolutions, or rather parts of a revolution, which it is made to describe during any exceedingly small period of time, beginning from that instant, is dependent upon two causes; first, upon the dimensions of the particular circle of the cone which is at that instant driving it, and, secondly, upon the particular angle through which it is driven by that circle, that is, it depends, first, upon the distance of its point of contact K with the cone from the apex of the cone at that time, and, secondly, upon the angle which the cone describes about its axis during that small period of time. Moreover, that if either of these two elements of variation remained always the same, then the number of revolutions, or parts of a revolution, made by the wheel, would vary directly as the other, whence it follows by a well-known principle of variation, that when (as in the present case) both these elements vary, it varies as their product; or that the number of revolutions, or parts of a revolution, made by the integrating wheel during any exceedingly small period of time, varies directly as the product of two factors, of which one is the angle described during that time by the cone, and the other the distance of the point of contact K of the cone and wheel from the apex of the cone.

Now the former of these factors has been shown to vary directly as the space described during that small period of time by the piston of the engine, and the latter to vary directly as the effective pressure which the steam is then exerting upon the piston of the engine.*

Thus, then, it appears that the number of revolutions, or parts of a revolution, made during any exceedingly small period of time by the integrating wheel, varies as the product of the space described by the piston of the engine during that time, by the effective pressure of the steam upon it during that time, that is, it varies as the *work* or *dynamical effect* of the steam upon the piston during that time. And this being true in respect to every small period of the time during which the stroke of the engine is in progress, is true of the whole stroke; whence it follows, that the number of revolutions, and parts of a revolution, made by the integrating wheel during the stroke is proportional to the whole work, or dynamical effect of the steam upon the piston during the stroke.

The integrating wheel carries round with it the frame G H, on the hollow axis of which frame is fixed a pinion running into a wheel, whose axis turns upon bearings fixed to the frame of the instrument, and the number of whose teeth is to that of the teeth in the pinion as ten to one. This wheel carries also a pinion running into a second wheel, their numbers of teeth being in the same proportion, and so through a train of five wheels and pinions. The circumference of each of the four last wheels is divided into ten equal parts and numbered, and the circumference of the first into 100. The number of revolutions of the integrating wheel is thus registered to five places of integers, and to one place of decimals.

Now this number of revolutions has been shown to be proportional, in respect to each stroke, to the work done by the steam upon the piston during that stroke; if, therefore, the action of the Indicator continued the same during successive strokes, or if the direction of the pressure of the steam upon the piston, and that of the motion of the piston, were not reversed at every stroke, then would the number registered during any number of strokes of the engine be directly proportional to the work done by the steam upon its piston whilst that number was registered. At the return-stroke of the piston of the engine, the pulley N, however, revolves backwards, and supposing it to carry with it the spindle of the cone, the cone also revolves

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* The Editor is indebted for the annexed engraving of the apparatus and description to a report of a committee appointed at the tenth meeting of the British Association. Members of the committee, the Rev. Professor Moseley, M.A., F.R.S., Eaton Hodgkinson, Esq., F.R.S., J. Enys, Esq.

* The position of the integrating wheel upon the piston-rod is so adjusted, that before the steam is admitted the integrating wheel may be brought, by the elasticity of the springs, exactly to the apex of the cone. In order to prevent it from being stopped by the apex of the cone, if accidentally it should be made to pass it, a solid piece projects from the frame of the instrument, having its surfaces adjusted so as to receive the edge of the wheel when it is forced beyond the apex of the cone, and to serve as a stop to the motion of the cone in the direction of its spindle when the resistance of the wheel is thus removed from it.

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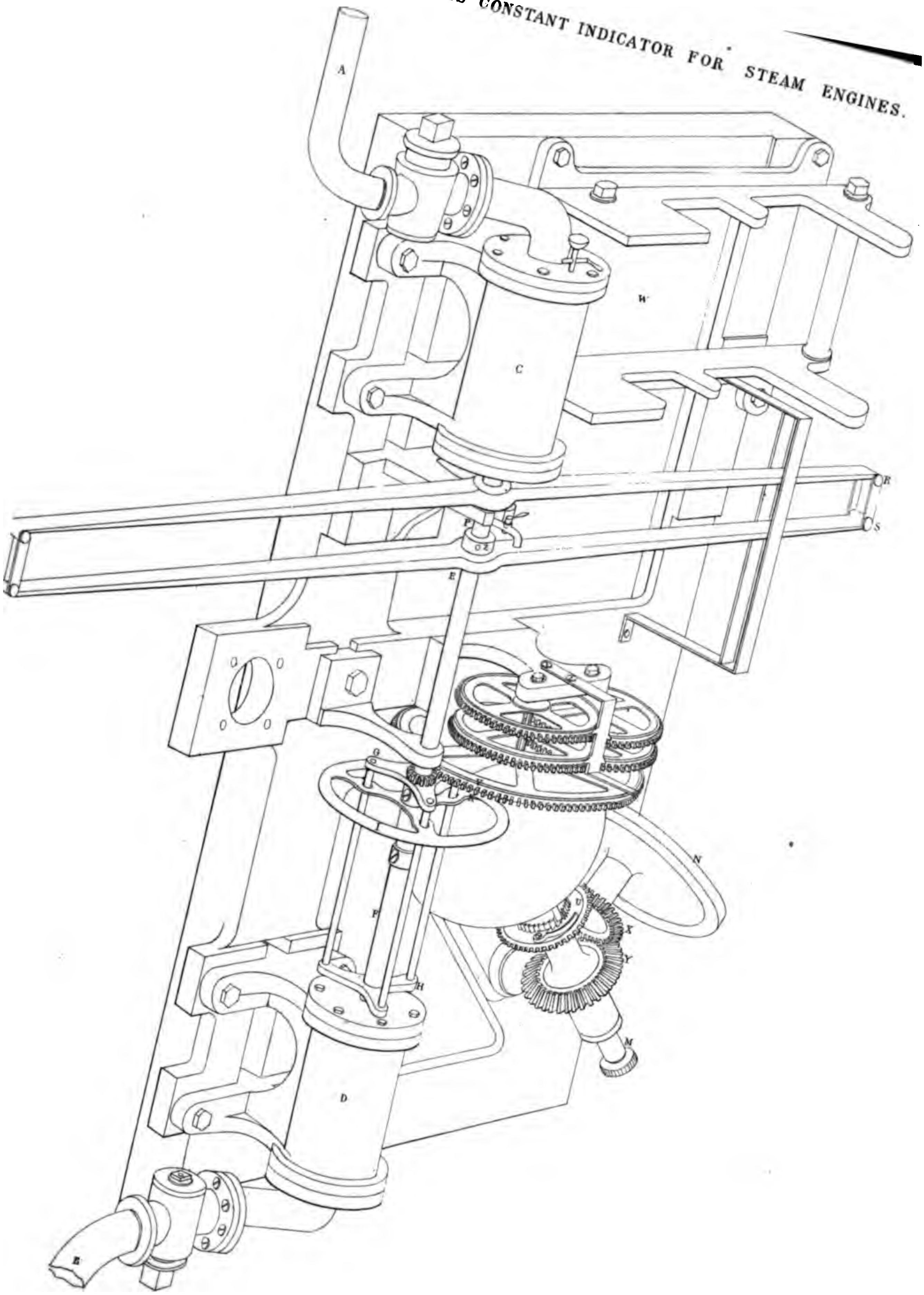
MOSELEY'S CONSTANT INDICATOR FOR STEAM ENGINES.



backwards, so that if the integrating wheel remain in contact with the cone at any other point than its apex, it too will be made to revolve backwards, and the number registered in the preceding stroke will thus be *diminished* by the number of revolutions made by the integrating wheel during this stroke: but let it be observed, that before the motion of the piston of the engine is reversed, the direction of the pressure of the steam upon it, and therefore the direction of the pressure upon the piston-rod of the Indicator is reversed, by which altered direction of the pressure, as well as by the elasticity of the springs, the integrating wheel is made to ascend to the apex of the cone, and to remain there during the return-stroke, so that no number whatever is registered during that stroke.

Thus, then, the remaining number registered during any time by the instrument when applied to the double acting engine, is proportional to the work done upon the piston by the steam at the alternate strokes during that time. The mathematical formula by which the work is determined from this number, and allowance made for the friction of the Indicator, is given in a subsequent part of this report.

In order effectually to guard against any error which might accidentally result from the reversed motion of the piston, a contrivance has been introduced in the combination of wheels Y, X, U, by which the revolution of the cone may be arrested whilst that reversed motion takes place. To adapt the instrument to register (if required) the work done at *every* stroke of the piston, a four-way cock has been constructed, which may be made, by the action of the engine, to control the direction of the steam passages of the Indicator, in such a way that the upper cylinder C shall always communicate with that portion of the cylinder of the engine which is filled with steam, whilst the lower cylinder D is made always to communicate with the vacuum. When the Indicator is thus used, the cone is made, by a simple adjustment of the mechanical combination U X Y, to revolve constantly *forwards*, whilst the motion of the piston of the engine, and therefore of the pulley N, *alternates*. It remains now only to speak of the application of the Indicator to the single acting engine, or Cornish engine.

The registration during the down or in-doors stroke of that engine is already explained. During the first portion of the *up* or out-of-doors stroke the equilibrium valve is opened, and the pressure upon both the pistons of the Indicator thus becoming the same, the integrating wheel is brought by the elasticity of the springs to its initial position at the apex of the cone, and thus, although the cone turns backwards, the wheel remains at rest and nothing is registered. When the equilibrium valve closes, the pressure of the steam in the upper portion of the cylinder of the engine, and therefore in the upper cylinder C of the Indicator, preponderates; the integrating wheel descends from the apex of the cone and the register revolves backwards, deducting from, or diminishing, the number before registered by precisely the number of units of work which is done by the steam (jammed back into the upper portion of the cylinder) *against* the returning piston. Now this is precisely the deduction which the theory of the steam engine shows ought in this case to be made, and the registration of each double stroke of the single acting or Cornish engine is, by this backward movement of the integrating wheel, *perfected*. Let it be here observed, that the Indicator in the *down*-stroke performs the definite integration of a *logarithmic function*, viz. that which represents the pressure of the steam as a function of space, described by the piston during the expansion of the steam, that it then calculates the numerical amount of the integral it has thus completed, and registers that amount; that it performs a similar operation in the up-stroke, and deducts the corresponding amount as a correction from the first.

The above must be received as an attempt to place the theory of the instrument under a general and popular form. A mathematical discussion of it accompanies this Report, in which the corrections due to friction and other causes are fully considered.

FORMULÆ FOR DETERMINING THE WORK OF AN ENGINE BY MEANS OF THE INDICATOR.

The following are the values of the constants which enter into the general equation in its application to the Indicator constructed by the Committee.

Radius of the integrating wheel.... $=\rho=2{\cdot}99$ in.

Radius of the piston of the indicator $=r^{*}=1{\cdot}125$ in.

Radius of the pulley measuring to the centre of the cord $=\mathrm{R}=3$ in.

Angle at apex of cone .... $=2\iota=90^\circ$

Friction of piston, of integrating wheel on cone, &c., mean value $=\mathrm{F}=1{\cdot}2074$ lb.

Additional deflection of springs due to each additional pound of pressure on piston of Indicator $=\lambda$ Spring No. $1={\cdot}028$.

Substituting the above values of ρ, r, R, ι in equations (2) and (3), we obtain for double acting engines,

$$\mathrm{U}=1{\cdot}67052\left(\frac{m}{\lambda}\right)\mathrm{N}-\tfrac{1}{4}\,\mathrm{F}\left(1-\frac{2}{p}\right)\mathrm{L}\ldots\ldots\ldots\ldots(4.)$$

for single acting Cornish engines,

$$\mathrm{U}=1{\cdot}67052\left(\frac{m}{\lambda}\right)\mathrm{N}-\tfrac{1}{4}\left(m\ \ \frac{2}{p}+\frac{1}{n}\right)\mathrm{F}\,.\,\mathrm{L}\ldots\ldots(5.)$$

If in these equations we substitute the values of λ for the different systems of springs, and also the *mean value* of F, which is 1·25 lb., we shall obtain for *spring No.* 1, $\lambda={\cdot}028$ in.

$$\mathrm{U}=59{\cdot}6614\ m\ \mathrm{N}-{\cdot}3018\left(1-\frac{2}{p}\right)\mathrm{L}\quad\text{(common engine).}$$

$$\mathrm{U}=59{\cdot}6614\ m\ \mathrm{N}-{\cdot}3018\left(1-\frac{2}{p}+\frac{1}{n}\right)\mathrm{L}\quad\text{(Cornish engine).}$$

The values of U, obtained from the above formulæ, being multipled by the number of square inches in the surface of the piston of the engine, will give the whole number of units of work yielded by it during the time of the experiment.

It will be observed, that no account is taken in these formulæ of the weight (3 lb. 0½ oz.) of the pistons, the integrating wheel, and the rod to which these are attached. The influence of this weight is, in fact, allowed for when, the springs being placed in the Indicator, and therefore loaded with it, and sustaining no other pressure, the integrating wheel is moved to such a position upon the rod as that its circumference may coincide with the apex of the cone. The springs are then just so much deflected as by their elasticity to sustain this weight, and that initial deflection remaining superadded to any additional deflection to which they may be subjected by the additional strain thrown upon them, the weight of the pistons, &c. will in every position be accurately balanced by it, and the additional strain thrown upon the springs will produce precisely the same deflections as though no such weight existed.

Mr. Moseley then described the difference between the instrument and that of M. Morin for applying the principle of M. Poncelet, to consist—First, in all those mechanical combinations which are peculiar to the instrument in its application to the steam-engine, M. Morin's instrument having been applied to measure the traction of horse.—Secondly, in the surface of a cone being substituted for the plane surface of a circular disc; by which arangement the rapidity of the changes of velocity due to corresponding changes in the position of the integrating wheel, is diminished in the same proportion in which the sine of one-half the angle of the cone is less than unity; and the force necessary to drive the integrating wheel being diminished in the same proportion, the chance of an error arising from the slipping of the edge of the integrating wheel on the surface from which it receives the impulse is lessened in proportion.—Thirdly; in the separation of the registering apparatus from the integrating wheel; by which separation, whilst the springs are relieved from the effect of the momentum and the friction due to the weight of the registering apparatus, the latter being in a state of quiescence, the registration is legible whilst the Indicator is in action.—Fourthly; in the variable position of the links connecting the springs together, by which variation the same series of deflexions may be obtained under different ranges of pressure. In fact, that the Indicator has nothing in common with the "compteur" of M. Morin except the principle of M. Poncelet and the springs under a modified form.

The amount of the friction of the pistons, was then examined and the peculiar construction of their metallic packing explained; it was shown also that instead of great difficulties arising from the friction of the integrating wheel upon the cone, or its slipping upon the surface, a very slight pressure of the spring produced sufficient adhesion to drive the registering apparatus. The professor then explained the advantages resulting from a registration of the duty of steam-engines generally, not during the time of a few isolated experiments, as with the common Indicator, but extended over any given period and through every stroke of the engine, displaying all the changes which had occurred during that time:—with this view it had been decided that the instrument should be attached to the engines of the Great Western steam-vessel on her next voyage to America.

He then expressed his obligation to Mr. Wicksteed for the facilities afforded him for the experiments at Old Ford, and paid a well-merited compliment to Mr. Holtzapffel for the excellent construction of the Indicator.

Remarks.—In reply to a question from Mr. Vignoles, Mr. Moseley stated that the instrument was not under its present form adapted to locomotive engines, but that a grant of £100 had been made by the British Association for the construction of such an instrument.

Mr. Cowper, in compliance with the request of Professor Moseley, illustrated his description by setting the instrument in motion, showing that the registration depended upon the revolutions of the integrating wheel: he demonstrated the cases of motion without pressure, and pressure without motion; in the former case the integrating wheel being stationary at the apex of the cone while revolving, does not receive any impulse from the contact with it, and therefore does not register; in the latter case, the surface of the cone upon which the integrating wheel traverses, being at rest, does not communicate any rotative motion to it, and consequently no registration can take place; but when motion and pressure are combined, the cone revolving and the integrating wheel travelling from the apex some distance towards its base, the exact product of the motion of the cone and the steam's pressure upon the piston would be registered by the amount of the revolution of the integrating wheel.

Mr. Wicksteed observed that every facility had been afforded to Professor Moseley for applying his new Indicator for the purpose of ascertaining the duty performed by the Cornish engine at Old Ford, but that he had not at all interfered with the experiments, being desirous of ascertaining whether the results would correspond with his trials. That after the work of the engine had been registered while it was making about 179,000 strokes, the mean result as stated by Professor Moseley was so nearly that arrived at by Mr. Wicksteed, that he had no doubt of the accuracy of the machine as a good indicator of the real duty performed by the engine, the difference in the result of the mean pressure of the steam, deducting the vacuum, or 0·73 lb., was 0·12 lb., namely, according to Mr. Wicksteed's experiments 12·94 − 0·73 = 12·21 lb., and according to Professor Moseley 12·09 lb.; this difference might arise from a variation in the mean length of stroke during the two sets of experiments—from a slight variation in the point at which the steam had been cut off—from a variation in the level of the water in the pump well, or other practical causes; the difference however was so insignificant, that he would rely on the accuracy of Professor Moseley's Indicator, and allow the possibility of a slight error in his own experiments.

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* The radius of the piston is so taken that its area may equal exactly four square inches.

Mr. Farey observed that Professor Moseley's instrument must be influenced by variations in the length of stroke, for whenever the piston makes a long stroke, the cone and the train of registering wheels, must be turned farther round, and would register a higher number than they would do in case of a shorter stroke; supposing the impelling force exerted by the steam to be always the same. If the instrument could be really made to give its results according to the actual length of all the varying strokes made during the time of observation, by truly aggregating these varying lengths into one sum, the results would be free from the usual uncertainty respecting an average length of stroke. In the monthly reports of engines in Cornwall, the performance is reckoned according to some reputed length of stroke, which had been fixed upon for each engine, when it was reported, and it is afterwards assumed that no departure from that reputed length has taken place, when, in fact, such departure does often occur.

It would be very desirable to have a moving card applied to the new instrument, in order to indicate the impelling force of the steam in the cylinder by tracing curves on paper, like those by the ordinary indicators. This it appeared might be done, with the advantage of causing the paper on which the curve is drawn to travel onwards and bring fresh paper into its place, so as to obtain a series of distinct curves for as many succeeding strokes.

The form of the springs of Professor Moseley's instrument would be a decided improvement if substituted for the spiral spring of ordinary indicators; Mr. Farey had applied to an ordinary indicator a mode of exhibiting at a glance, whether the engine was exerting more or less force than its ordinary appointed task; the plan answered that purpose: but as it required the indicator to be always in action, the spring of the indicator broke after working more than two days, he therefore abandoned it. The springs in the new instrument were proved by the trial at Old Ford to be capable of enduring continual exertion without breaking. The professor had stated that the scale of flexure of the new springs was found to be exactly, according to theory, equal divisions with equal forces; this might be expected because the flexure of the springs was small, and the bending force acted in a direction nearly at right angles to the length of the springs. In ordinary indicators the scale should not always be equal divisions, because the wire of the spring being wound spirally into a screw of small diameter, the spiral obliquity of the thread of such screw becomes more oblique to the direction of the bending force, as the spring is stretched, and less oblique as the spring is compressed, and hence the scale of pounds per square inch by which the curve should be measured for summing up the results, ought to be a scale of unequal divisions.

The indicators originally used by Boulton and Watt were of a large size, with a long and powerful spring curled into a cylindric form, as large in diameter as could be included in the cylinder of the indicator, and the motion allowed to the piston by the spring was very short; such indicators were judiciously proportioned, and they do not show any sensible inequality of divisions in their scale. But recently, indicators have been frequently made without the knowledge of their true principle, and the rules of proportion are not observed, so that it will sometimes be found, on actual trial of such instruments with weights, that their scale of pounds per square inch is not in equal divisions, although it is usual to employ a scale of equal divisions for summing up the curves traced by them. In Boulton and Watt's indicators the scale of pounds per square inch was formed from actual trial with weights, but such trials were made when the indicator was cold, and dismounted from its place upon the steam engine. A much better mode is to apply the weights on the upper end of the piston-rod when the indicator is placed on the cylinder of the engine, while it is hot, its piston being supplied with the same quantity of oil, and the spring being in the same state as when it is in use. The depression of the piston by the weights is recorded by drawing a line with the pencil of the instrument on the card itself, in the same manner as the usual atmospheric line is drawn thereon. A series of lines thus drawn with given weights, become so many original stages for subdividing between them, to form a true scale for summing up the curve described under the same circumstances and nearly at the same time.

Professor Moseley's instrument had two cylinders and pistons operating in concert on the same piston-rod, and springs of peculiar construction to indicate the unbalanced pressure exerted by the steam to impel the piston of the engine. The elastic force wherewith the steam acts above the piston (called the positive pressure or plenum) is shown by a common indicator, but the elastic force wherewith the uncondensed steam is at the same time reacting beneath the piston (called the negative pressure, or imperfect exhaustion or vacuum) is not shown; hence the observations are limited to two odd halves of the stroke made by the piston, those halves being commonly the plenum during the descent, and the exhaustion during the ascent of the piston; it is taken for granted that the other two odd halves are the same as those which are observed, although such assumed parity is not always the true state of the case. In the new instrument the indication that it would make by drawing on a card, would be that of the difference subsisting between the plenum above, and the exhaustion beneath the piston of the engine, during its descent, and ascent, wherefore it would indicate on one card as much as two ordinary indicators can do on two cards. if they are applied one to the top and the other to the bottom of the cylinder of the steam-engine; in that case each indicator shows on its own card what the elastic force of the steam is during the plenum, and what it is during the exhaustion, but the required result (which is the difference between the two) must be obtained by combining together in the computation those distinct curved lines which are drawn on two separate cards. Professor Moseley's combined indicator pistons, acting on the same springs, would at once indicate such difference by the curve which it would trace on the one card.

In answer to a question from Mr. Parkes as to whether the new instrument had been put to any other test than its apparent agreement with Mr. Wicksteed's estimate of the resistance overcome; and whether the common indicator had been applied to the engine at the same time, Professor Moseley said that he had not compared the instrument with any other, but had subjected Mr. Wicksteed's calculations to a rigid investigation, and felt quite satisfied that they approximated closely to the truth. He relied upon them as corroborations of the accuracy of the instrument.

Mr. Parkes observed that it would have been more satisfactory to engineers to have been assured that every means had been taken to demonstrate the truth of the results recorded by an instrument which had such important functions in view. He wished to know in what manner the pressures denoted had been ascertained—whether by weights or by comparing them with a mercurial column. He had found the latter mode more exact than weights in verifying the scale of the common indicator, as the instrument being heated was then in precisely the same state as when it was in use. He had found that a certain amount of correction was frequently necessary, as both the spring and the amount of piston friction were affected by heat.

Professor Moseley replied that the instrument had not been compared with the mercurial column, but that the resistance of the springs, and the friction of the piston and instrument generally, had been ascertained by very accurate experiments, so that he had full confidence in the results.

Mr. Parkes said that notwithstanding the respect and deference he felt for Professor Moseley's attainments and ingenuity, his past experience would not permit him to place entire confidence in the results afforded by the instrument; indeed he considered them to be altogether fallacious as representing the force acting on the piston of the Old Ford engine. He could not admit that the apparent near identity between Mr. Wicksteed's computations of resistance, and the constant indicator's registration of force, amounted to proof of the instrument's accuracy; for it seemed to him that Mr. Wicksteed had omitted to take into account one important item of force, without the exertion of which a piston could not be brought from a state of rest into a state of motion. He referred to the force required to give velocity to the piston. Mr. Wicksteed had weighed the greater part of that resistance which might be called ponderable, and had estimated the remainder, assigning about 12 lb. per square inch on the piston as the total amount, after deducting the resistance to the piston's descent arising from uncondensed steam. Thus, an elastic force of 12 lb. on the piston would counterpoise a resistance of 12 lb., but motion would not ensue until a superior force were applied. Considering the number of strokes made by this engine per minute, Mr. Parkes could not estimate the velocity of the piston at less than from 300 to 400 ft. per minute, which was very great for this enormous mass, and would require the exertion of proportionate power. He regarded the piston of the engine, loaded with 12 lb. per square inch, as he would a ball of 12 lb. weight in a gun balanced by a fluid of a corresponding elastic force; but such ball would remain motionless unless it were propelled by some additional force. This state of things had been denominated by Professor Barlow "the preparation for motion." Now as Mr. Wicksteed's estimate proceeded no further than the production of this state of things, and as Professor Moseley's constant Indicator recorded the mean pressure of the steam in the cylinder as barely equal to it, he could not assent to the accuracy of either method of determining the total resistance overcome by the steam.

Mr. Parkes would cite the experience of others as to the quantity of force actually expended in giving velocity in a Cornish engine, over and above that necessary to balance the weight at the opposite end of the beam, friction, &c. included. In the fifth part of Vol. III. Trans. Inst. C. E., Mr. Enys has reported some experiments made at Mr. Parkes' suggestion, on several engines. He would cite those of the Tresavean, as the cylinder was of the same diameter as the one at Old Ford, viz., 85 inches. The water load was equivalent to 12 lb. per square inch on the steam piston, and when about half the usual velocity was given to the piston in the in-door stroke, a pressure of about 17½ lb. was denoted throughout the stroke, by a mercurial column connected with the cylinder. Mr. Loam had since transmitted to him the following abstract of experiments made on the same engine, January 28, 1842. "Two indicators were used at the same time, and an open mercurial gauge; the engine was held in-doors until the mercury became stationary, in order to ascertain the *minimum* quantity of steam power necessary to produce motion. The pressure was 15 lb. per square inch, when the water load was 12 lb." Here, then, a force of 3 lb. was found requisite to establish an equilibrium between the power and resistance; and a further force of 2¼ lb. per square inch was necessary in order to urge the mass at about the half of its ordinary velocity. Mr. Enys stated that less pressure was exhibited when the engine was brought in slower, and *vice versâ*; and this was consistent with everyday experience. Now, though the Old Ford engine had not to overcome so much frictional resistance as a deep mine engine, yet, having a weight to raise, according to Mr. Wicksteed, alone equal to 11·8 lb. per square inch on the piston, Mr. Parkes was of opinion that this could not be effected at the usual working velocity, with less than 14 or 15 lb. pressure of steam per square inch. He would suggest to Mr. Wicksteed, to repeat Messrs. Enys and Loam's experiments, and also to work his engine with steam reduced nearly to such pressure in the boiler as would barely suffice to bring the piston down. Such experiments would confirm or invalidate the results given by Professor Moseley's instrument, and probably lead to the discovery of its imperfections, should any exist.

It appeared that Mr. Wicksteed conceived a greater amount of elastic force to be required to perform a stroke in proportion to the degree of expansion given to the steam in the cylinder. He would quote the pressures deduced by Mr. Wicksteed under five cases of expansion, as they exhibited some curious anomalies. They were taken from Table VI. of Mr. Wicksteed's Treatise. According to his table, when the steam was stopped at 6 ft. of the stroke, the mean force exerted during the stroke of 10 ft. was 13 lb. per square inch; at 4¾ ft., 13½ lb.; at 4 ft., 14¾ lb.; at 3⅓ ft., $15\frac{4}{10}$ lb.; and at $3\frac{1}{11}$ ft., 15½ lb. It must be observed that in every one of these cases, the resistance, as appreciated by Mr. Wicksteed, amounting to 13 lb. per square inch, was a constant quantity; so that, for some unexplained reason, an invariable load appeared to require a variable force to overcome it; a sliding scale of power, given as the measure of a constant resistance. It was possible that some small difference might have existed in the velocity of the stroke, in these cases; it was also possible that some error existed in the method used for determining the pressures, or in the evaporative quantities. However this might be, it was clear there was an error somewhere, as it could not be granted that an effect deemed constant in all these cases could require a varying cause for its production.

As these appreciations differed widely from each other, and still more so from the indications of Professor Moseley's instrument, Mr. Parkes hoped that Mr. Wicksteed would re-consider and verify this part of the subject. In corroboration of his opinion that the acting force recorded by the instrument is too low, he would draw attention to the circumstance that, during the period of its application (28 days), the duty performed by the engine for each 94 lb. of coal amounted only to about 68½ millions, and it would not be unreasonable to expect that at least 150 millions should have been the result under the different circumstances of mine and water-works engines, as 100 millions had been performed for some months by mine engines under a water load equal to 12 lb., and a mean steam pressure of 18 lb. per square inch of the piston. Whereas, if the water-load of 11 lb. at Old Ford was overcome by an amount of force little exceeding 12 lb. per square inch, a proportionate increase of duty ought to have resulted, but such was not the case.

Mr Parkes then proceeded to comment on the phrase "*effective power*," which he understood from Professor Moseley, as significant of the force of the steam, or piston pressure, measured by his instrument. He thought that phrase more strictly applicable to the amount of power given off by the engine, when ascertained, as it might be in the case of pumping engines, by the weight raised; or, as it could only be determined on rotative engines driving machinery, by a dynamometer applied at the extremity of the crank shaft. He would illustrate this by an example. There was at Birmingham a corn-mill belonging to Mr. Lucy, worked by an excellent engine of 40 H.P., made by Messrs. Boulton and Watt. This engine had a fly-wheel weighing 24 tons, and nine pairs of stones were driven, besides dressing-machines. Mr. Lucy had taken out a patent for an apparatus as a substitute for the fly-wheel, which had been removed. The engine so altered now drives ten pairs of stones, under the same pressure of steam, and with the same consumption of fuel as before. Thus, what he should denominate the "effective power" of the engine was increased, by this simple change, eleven per cent. Yet Professor Moseley's instrument, or any other indicator, would have exhibited, both before and after the alteration, the exertion of a precisely equal force on the piston. Neither did the Professor's instrument register the *absolute*, or what Professor Whewell had denominated the "*labouring*" force of the steam on the piston of an engine, as it made no deduction of the amount of force, whatever it might be, which was necessarily expended in overcoming the resistance opposed by the uncondensed steam. Its construction permitted it only to record the difference of these amounts. For these reasons he could not regard the instrument as likely, even when made trustworthy, to become of that utility to engineers which was the Professor's aim and hope. There was a greater need of an accurate dynamometer capable of showing the effective power of an engine whilst in regular work, and he was happy to say that this desideratum had been supplied by Mr. Davies of Birmingham, by whose permission he would take an early opportunity of describing to the Institution the construction and efficacy of this instrument. It was very important that a self-registering machine should be made, capable of recording the mean steam pressure operating throughout a stroke of the engine, but it was still more important that this registration should be accurate; and he hoped that the remarks which had been made would only urge Professor Moseley to farther investigations, and induce him to enlarge as much as possible the useful powers of the instrument.

Professor Moseley observed that when a body passes from a state of rest, through a state of motion and into a state of rest again, or from a state of motion at a given velocity through a state of motion at a different velocity, and back to its first velocity again, then is the work which must be done upon it by the moving power the same in amount, whatever may have been the velocity thus intervening between the two states of rest or of equal motion of the body, provided that the resistance opposed to its motion and the space through which that resistance is overcome be in all cases the same.* In Mr. Wicksteed's engine the resistance thus opposed to the motion of the piston, and the space through which that resistance is overcome at every stroke, are thus constantly the same (or in other words, the work done upon the resistance is the same at every stroke of the engine), and the piston passes at every stroke from a state of rest, to a state of rest again; it follows therefore by the above well-known principle of "vis viva," that the work done by the steam, as the moving power upon the piston of the engine whilst it completes a stroke, is the same, whatever may be the velocity communicated to it, and to the mass which it carries with it, at any period of the stroke. It is true that to put the piston, and the mass carried along with it, at first in motion, a pressure greater than the resistance is required, and therefore greater than the mean pressure necessary to complete the stroke; a pressure equal to the resistance would only bring it into the state of rest bordering upon motion; to cause it to pass from this state of rest to a state of motion, more pressure is required, and the more as the velocity to be acquired, whilst it moves through a given space, is greater; or in other words, in order to communicate any given velocity to a body whilst it moves through any space, there must be an excess of the work done by the driving pressure through that space, over that expended upon the resistance through that space; but all this excess is accumulated, and unless the steam pressure be afterwards made less than the resistance, or unless the steam be afterwards expanded through a distance dependent on the amount of this accumulated work, so that it may expend itself in overcoming the surplus resistance through that space, then the piston will strike upon the cylinder bottom. This principle may be illustrated by an example; suppose that the load upon the piston of an engine is 10 lb. per square inch, and that the steam is admitted at a pressure of 15 lb., it is evident that by reason of the excess of 5 lb. pressure of the steam above the load, the velocity of the piston will be made continually to increase until the steam is cut off, and afterwards, so long as the steam pressure exceeds the load, or until by its expansion the steam pressure is reduced to 10 lb. per square inch. Up to this point the velocity of the piston and of the mass moving with it will continually have been increasing, a great momentum will therefore have been acquired by it, and this momentum will carry it on to the completion of the stroke; although after this position is passed, the steam pressure will be less than the load, and would by itself be insufficient to remove it. In other words, the work done by the steam upon the piston will have continually exceeded that expended on the load up to this period of the stroke, and the surplus will have been accumulated in the moving mass,† which surplus work will carry on the piston to the end of the stroke when a cylinder full of steam will be delivered of greatly less pressure than the load. If the steam had been worked at full pressure, it is evident that at every stroke a cylinder full of steam would have been discharged of the same pressure as the load. In this consists, therefore, the advantage of working expansively. It is evident that the piston acquires its maximum velocity at the point where the steam pressure becomes equal to the load, and that the engineer, by the manipulation of the steam valves, produces that adjustment by which the velocity acquired by the piston at this point (or the work then accumulated in it) is caused to be just sufficient to carry on the piston to the end of the stroke, but without striking the cylinder bottom; it is moreover evident that the greater this maximum velocity can be made, the farther the piston will be carried beyond the point where the steam pressure is equal to the load, and the less will be the pressure of the cylinder full of steam discharged at the completion of every stroke, or the greater the economy of the steam power.

A second illustration of the same principle may be drawn from the effect produced by a pressure suddenly thrown upon a spring. Suppose a spring which would rest deflected through an inch under a pressure of one pound. If when this spring is in an undeflected state this pressure of one pound be suddenly thrown upon it, it is certain that the spring will, at first, deflect considerably beyond that distance of one inch in which its deflection will eventually, after many oscillations, terminate. In fact, if it is thrown on with mathematical suddenness, the first deflection will be two inches. To explain this, let the pound weight be supposed to be applied gradually to the spring by dropping grain after grain of sand slowly upon it. The spring will then evidently be brought to its deflection without ever passing it. Now let it be observed that on this supposition the first grain of sand only will have descended through one inch, the next descending through less than an inch, the next through yet less, and so on. Thus the work done upon the spring by each succeeding grain will be less than that done by the preceding. Yet the aggregate work done by these successive small pressures, each working through a different space, is sufficient to deflect the spring one inch. Now let all the grains be placed at once upon the spring. When it has deflected an inch, each grain will then have worked through an inch, and a great deal more work will, on the whole, have been done on the spring than before, indeed twice as much; but the work done before was enough to deflect the spring an inch; more than enough to deflect it has now therefore been done, that is, more has been done than has been expended. The remainder is accumulated in the moving mass of the sand and the spring, and carries on the deflection greatly beyond the position of equilibrium.

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* This is a principle well known to mathematicians as resulting immediately from the principle of "vis viva," and is as old as the days of D'Alembert; it appears first to have been applied to questions of practical mechanics by MM. Coriolis and Poncelet.

† The number of units of work thus accumulated is represented in lb. one foot high by $\frac{1}{2}\frac{w}{g}v^2$; whence w represents the number of lb. in the weight of the moving mass, v its velocity in feet per second reduced to the piston $g = 32\frac{1}{6}$ lb. The expression $\frac{w}{g}v^2$ is said to represent the vis viva; so that the accumulated work is equal to half the vis viva.

The Indicator was placed upon the engine of the East London Waterworks, in the belief that by the experiments of Mr. Wicksteed, the work actually performed by that engine was better known than that of any other. All the calculations and inquiries which have since been made have fully confirmed that opinion. And he had full confidence in that verification of the registration of the Indicator which is supplied by its agreement with Mr. Wicksteed's estimate of the work of his engine.

In reference to the use of the term "work," Professor Moseley stated, that the various terms used by foreign engineers to convey the idea attached to that term, appeared at length to have resolved themselves into the single term "travail;" and that of the variety of corresponding terms used in England, the term "work" was probably the most obvious translation of "travail;" that it moreover appeared to him the simplest and the most intelligible; and that on these grounds he had adopted it.

In answer to the observation made by Mr. Parkes suggesting the construction of an indicator which would register the work of the machine at the point where it is applied, instead of at the cylinder of the engine, Professor Moseley stated that such an instrument would undoubtedly be very valuable, especially if it could be made to register correctly the work transmitted by a rotating shaft; but that for the purpose contemplated by him it would be entirely useless—this object was to effect, in respect to ordinary engines working under constantly variable pressures, that constant registration of the duty, the introduction and publication of which had led to so remarkable an economy of steam power in the working of the Cornish engines. No registration of the work done at the working points of the machine driven by the engine, would supply a fair estimate of the duty done by the engine; a greater or less portion of the work done by the engine being lost by reason of friction in its transfer through the machine, from its driving to its working points, according as there was a greater or less complication of moving parts and rubbing surfaces intervening. He repeated that his object had been to determine the working qualities of the engine itself; and that he had for this reason specially sought to eliminate from his estimate those very influences of the friction of the machine driven by the engine which Mr. Parkes thought it so important to include in it. It would have been a fault of his Indicator (for the purpose contemplated by it) if it had taken any notice of the effect of that change made in the machinery of Mr. Lucy's mill, which Mr. Parkes had spoken of. He had used the term *effective* work (not effective power) of the engine, to signify that excess of the work of the steam on one side of the piston, over that opposed to it by the imperfectly condensed steam on the other, which it was necessary to know in order to estimate the real duty of the engine. It was solely for the determination of that duty that the Indicator had been constructed, and the alterations which Mr. Parkes had suggested would have subjected its registration to influences which, in reference to that purpose, he had specially sought to eliminate.

Mr. Farey remarked, that it would lead to an incorrect appreciation of the merit of the new indicating instrument, if it were to be considered merely as a substitute for the ordinary indicator, when in fact they are two instruments, adapted to and equally useful for different purposes. The new instrument does not preserve any record of the minute details of any one stroke, like the ordinary indicator, but it records a true aggregate of all the details of any number of succeeding strokes; it gives the same results as would be obtained if it were possible to have two ordinary indicator cards correctly taken, at each succeeding stroke of the engine, during the whole time of observation, by means of two indicators, one of them applied to the upper, and the other to the lower end of the cylinder; and also provided, that an accurate admeasurement of every one of all those cards was afterwards made, at ten places in the length of the card, by the scale of pounds per square inch, in the usual manner, and the amount of the ten measurements added into one sum, and then (without averaging each card) that such sum of each card should be carried to a continuous account to obtain a grand sum total representing all the force that had been exerted, during both halves of each stroke made throughout the experiment, reckoned at ten stages or portions of the length of stroke. Such a grand total of all the cards would be a number representing the same fact, as is represented by the number shown by the new instrument; and would therefore be dealt with, in each case, in a similar manner, as one of the data (viz. that representing force) for calculating (by aid of other data representing motion or space) the whole power exerted during the time of observation.

In trying the performance of a steam vessel, alternately up and down a measured mile in the river Thames, it is usual to take an indicator card from each engine, at every such run; and by summing up each card, some difference will be found between them, wherefore an average of the results of several cards will give more authentic information respecting the force exerted by the engines during the whole trial, than could be obtained if one such card alone had been depended upon. The new instrument takes cognizance of every stroke that is made by the engine during the whole time of observation; and in cases (such as in the Great Western steamer) where a considerable variation of force in succeeding strokes occurs frequently during such time, it is a desideratum to obtain the results which this instrument is intended to give, and which, as far as it has been tried, it seems likely to give with fidelity.

The instrument when applied as it had been at Old Ford, becomes another mode of ascertaining performance, similar to what is reported monthly respecting the engines in Cornwall, but not exactly the same as is there called "duty," because the new instrument would show the aggregate of the unbalanced force, that had been exerted (during a given time) by the steam, to impel the piston; whilst the monthly reports show (by load in pounds, length of stroke in pumps, and number of strokes made) the aggregate of force exerted in the same time, in overcoming the resistance that the mere hydrostatic weight of the columns of water in the pumps, opposes to the motion of the engine.

The instrument ought always to show more force than the reports do, and the difference between the two, would be the aggregate of all the force that had been lost during the time, by friction of the moving parts of the engine, pumps, &c. Respecting that loss of force, there is no more of it than arises from such friction, from working the air-pumps, &c., and from resistance of the water, but it is wholly a mistake to suppose that any such loss is augmented by producing motion. Professor Moseley had just stated the true theory on that head, which theory was demonstrable mathematically, and admitted of no question. It would be needless to go further into what had been so well explained, except to observe that the theory applies without the least abatement, or modification by incidental causes, to the case of any machine which, like a steam engine, regains the same state, as to rest, (or as to motion) at the end of the time of observation upon it, as the state in which it was at the commencement of that time; and the theory shows that in such a machine, no part of the force exerted upon it (or exerted by it) can have been expended, or lost, in producing motion, whatever may be the number or the extent of changes or variations in velocity of motion, that the machine had undergone during the time of observation; for although force must be exerted to produce motion from a state of rest, yet all force that is so exerted will be rendered back again when the motion which was produced has ceased, and the state of rest regained; in the steam engine that is the case at the termination of every half-stroke. Respecting trials by means of the smallest force of steam, which will just press the piston of a pumping engine slowly down in the cylinder, or cause the engine to come creeping in-doors: they are not much to be depended upon as evidence of the force that is actually lost in overcoming friction; first because no steadiness of exhaustion can be kept up beneath the piston, nor steadiness of steam above the piston, whilst the engine is so treated, and also because the counterweight of engines in Cornwall is not apportioned with any great nicety. In general they are worked with more counterweight than is requisite, and but little loss is occasioned by so doing; for if the counterweight is unnecessarily great, so as to carry the engine quick out of doors (that is, to cause the pump-rod to descend briskly) then the equilibrium valve is closed sooner, and therefore retains more steam between the top of the piston and the cover of the cylinder, in what has been called the steam cushion, which stops the descending motion of the pump-rod; and in consequence of more steam being reserved in such cushion to go towards the supply for the succeeding stroke, that increase in the reserved steam compensates in part for the waste of force occasioned by the redundancy of counterweight, which caused the quick motion.

Mr. Farey had received from Mr. John Taylor indicator cards of Taylor's engine at the United Mines; one card was taken soon after it was first set to work, with an extravagant counterweight, and another card was taken immediately after several tons of balance had been added without alteration of the load of water in the pumps; balance in Cornwall is contrary to counterweight, so that adding balance effects a reduction of counterweight. Now if an attempt had been made to ascertain the friction of that engine by trying what strength of steam would cause the engine to creep in-doors, the day before the balance was added, the friction would have appeared (by that mode) to have been 3 lbs. or 4 lbs. per square inch greater than it would have appeared to be after the balance had been added; although that was an extreme case not likely to occur often, yet errors in the imputed amount of friction, to the extent of 1 lb. or 1½ lb. per square inch would be continually made, if dependence were to be placed on that mode of trial of engines working with so much counterweight as they may happen to have. The friction of modern engines in Cornwall, including that of their pit-work and pump, and the resistance of the water, he believed would not be found materially, if any, greater, than was the case in Mr. Watt's old engines, when the depth of the mines was not half as great, and the weight of moving parts not one-third as great; for the improvement in pit-work and pumps, and engine-work, had kept pace with that increase of depth and weight. The pump-rods are hung more truly perpendicular, and the lengths of timber for the rods are better jointed so as to cause them to hang straighter in the pit whilst working, and avoid lateral vibratory flexure, and therefore the rods rub less against their guides; the plungers are set truer, and being of large diameter, have less rubbing surface in proportion to their contents, the lifts being higher, and short lifts being avoided; these and many other improvements tend to reduce the friction in proportion to the force exerted.

The small quantity of steam expended, and consequently of water injected into the condensers, as well as better joints to prevent leakage of air into the exhausted parts reduces the power required to work the air-pump to a smaller proportion of power exerted by the engine than formerly. And in particular the valves and water-ways through the pumps are made more open than formerly, so as to diminish the loss of force that is occasioned by resistance of the water; that loss of force by resistance increases as the square of the velocity of the motion, when loss of force by mere friction does not increase by increase of that velocity. He believed few large engines in Cornwall, which are making what is now thought tolerably good performance, lose more than at the rate of 3 lbs. per square inch of the piston, by friction of their moving parts, and by resistance of the water, and by working their air-pumps, and the best and newest engines probably still less. It would of course be understood that he meant by 3 lbs. what is commonly called 1½ lb. for moving the engine each way, or through each half stroke; but that is not a correct way of stating it; 1¼ lb. friction in coming in-doors, and 1¾ lb. friction and resistance of water in going out-of-doors, would be more likely to be correct. With all that has been done in Cornwall, these matters still admit of further improvement.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

TWELFTH MEETING, 1842.

[WE are indebted for the following report partly to our own correspondents, and partly to the *Athenæum* and the *Manchester Guardian*—the latter paper gave a very copious account of the whole of the proceedings, including the speeches delivered at the dinner.]

REPORT FROM THE COMMITTEE ON RAILWAY SECTIONS, presented by Professor Vignoles.

A grant of 200*l*. from this Association was made at the Glasgow meeting in 1840, on a joint application from the Geological and the Mechanical Sections, towards obtaining profiles of the various railways, chiefly with a view of putting on record (before the slopes of the excavations become soiled over and covered with vegetation) the geological appearances and strata developed in the many vast openings made through the country by the operations of modern engineering. At the Devonport meeting last year a renewal of the unappropriated balance of the first grant was made; the whole sum has since been expended, and the results are now laid before the Sections originating the subject, in the shape of the numerous working plans and sections of several of the railways, and of the enlarged parts of the profiles of the excavations.

In obtaining these the Committee appointed by the Association have great pleasure in reporting, that they have been aided in the most effective and satisfactory manner by all the railway companies to whom they have applied, and also by their several officers, the engineers in particular having taken extreme pains and great interest in forwarding the views of the Association. When so many parties have thus zealously co-operated, it might be almost invidious to name one without specifying all; but in particularly mentioning Mr. Swanwick, the engineer of the North Midland Railway, the Committee wish to do so for the purpose of remarking on the great pains taken by that gentleman in marking, as his works went on, all the geological details of the cuttings, which pass through so interesting a region, and which has put into the possession of the Committee a vast extent of most valuable records of the kind sought for, and which at the same time forms a most striking example, well worthy of imitation, of the combination of engineering and geological information, applicable for economic purposes.

The Committee were not at first able to organise a system of working the grant to their entire satisfaction; but they found after some experience that, with the favourable disposition shown by all the railway companies, they might (without increasing the expense,) by degrees and in no great time, be able to form an interesting and valuable collection, not only of the sections of the excavations of the railways, but of the whole of the plans and profiles of all the lines, which, concentrated in one public depository, and open to the inspection of all scientific and literary bodies and individuals, and to the public in general, under proper regulations, would be of high interest. In fact such documents were almost necessarily required, as the mere indices whereby to identify the particular geological profiles; and so useful and important is such a collection likely to become, that it is not unreasonable for the Committee to hope and believe, that after another year's experience shall have matured their arrangements and perfected their proposed system of records, and brought down the expense to a certain and moderate rate per mile, the subject may be taken up by Her Majesty's Government, and made to form part of the great geological survey of the United Kingdom, conducted by Sir Henry De la Beche, in connection with the trigonometrical survey now carrying on by Colonel Colley and the officers of the corps of Royal Engineers. The Committee, therefore, are not without hopes that the geological and mechanical Sections will again unite in applying to the General Committee for a further grant of 200*l*. at the present meeting, to enable them to complete the organization they have began.

The documents which the Committee have to submit are the following:—

1st. Plans and sections of the whole of the Midland Counties Railway from Rugby to Derby and Nottingham, about 58 miles. Enlarged sections of the cuttings on that railway, prepared to be filled in geologically. The chief characteristics of this district are the gypsum beds, commonly called plaster of Paris, and the hydraulic lime, well known to engineers as the Barrow lime.

2nd. Plans and sections of the whole of the North Midland Railway, from Derby to Leeds, about 72 miles. The entire of the geological details have been laid down on the working sections of the cuttings; but as it has been considered by the Committee that a uniform system should be observed enlarged sections have been prepared, on which, as on the similar sections of the other lines, the strata should be delineated. It may be observed here, that these enlarged sections are on the natural scale of 40 ft. to an inch, that is, the vertical and horizontal scale are alike, which is not always the case in ordinary geological sections, and very seldom so with the working sections, for earth work and similar engineering purposes. This railway intersects the coal districts for many miles, and is replete with interesting objects.

3rd. Plans and sections of the Manchester and Leeds Railway, from Manchester to Normanton, about 50 miles. These latter are not quite finished, but will be so before the close of this meeting. Enlarged sections of a considerable portion of the excavations on this railway, are filled up with the geological details.

4th. Enlarged sections of the excavations on the Glasgow, Paisley, and Greenock Railway, about 22½ miles, with the geological details.

5th. The same for the Manchester and Bolton Railway, about 10 miles, containing full details of the strata where the remarkable fossil trees were found, and of the trees also, models of which are in the exhibition room at the Royal Institution in Manchester. The liberality of this company will afford several opportunities for the members of the Association to visit these trees, and the particular profile of the excavation where they are will remain in the Geological Section, or in the Royal Institution, where the models are.

6th. Enlarged sections of the Hull and Selby Railway, about 30½ miles, with the geological details.

Some other enlarged sections are stated to be preparing for the Committee, but they have not come to hand in time for the present report.

These records, according to the directions of the Association, will be deposited in the Museum of Economic Geology, in London, where they may at all times hereafter be usefully referred to.

In conclusion the Committee cannot refrain from observing that the documents thus collected are equally important and interesting to the philosopher, the geologist, and the engineer. To the philosophical or theoretical investigator they present the curious and varying features of the crust of this portion of the globe; to the practical engineer they offer a memorial of the experience of the profession, whence many a serviceable lesson for future operations may be learned; whereby difficulties and expense may be hereafter avoided and diminished, and from which valuable information may be derived for the appliance of materials in constructions, it being one of the great arts of the engineer to avail himself of the most immediate natural resources which he has to displace in one instance, and to apply them usefully in another, when in juxta-position. And, on the other hand, the minute variations of strata and soil thus accurately delineated, and referred to well-defined altitudes, with respect to the general surface of the ocean, become of the very highest interest to the geologist, and no less so to the mining engineer, more especially on the lines of railway intersecting the coal and mineral districts, where, in numerous instances, labour, directed by science and sustained by commercial enterprise, has laid bare in deep chasms the secrets of Nature, and the stores whence this country has derived so many advantages, and whose well-directed energies have drawn from our mines of coal and rude metals that abundant wealth and prosperity which the more splendid productions of Potosi and Mexico have failed to bestow on their possessors.

ON STRAIGHT AXLES FOR LOCOMOTIVES, by Prof. Vignoles.

The fatal results of the late terrible catastrophe on the Paris and Versailles Railway (*rive gauche*) has drawn the attention of the public in general and engineers in particular, to the causes which produce such fearful effects; and the breaking of the axle having been prominently put forward as the original occasion of this and many other railway accidents, it seems desirable that a dispassionate inquiry should be instituted, and an endeavour made by calm discussion to elucidate truth.

It is not intended, in the present note, to allude, except in general terms to the above accident. It is clear that the breaking of the axles in this case was not of itself sufficient to produce such a disaster. It was not the driving axle that broke, but the fore axle of the small four-wheeled engine; and it was with great regret that I perceived the cause of the accident attributed to the principle of construction of the machine. It must be quite evident to all engineers who have attentively read the details of the accident on the Versailles Railway, and of the one that occurred on the London and Brighton Railway soon after the first opening, that the same causes were in operation, and greatly aggravated the sad results in both instances, viz. the coupling together of two locomotive engines of unequal power and of different constructions, the smaller in advance :—On both occasions a long train of heavily laden carriages were moving at very high velocities on a falling gradient; on the occurrence of the accident to the smaller engine in front, the driver suddenly turns off the steam ; the man on the larger engine behind, from whatever cause, does not act simultaneously, and a few seconds continuance of the vast unchecked momentum of the heavy engine with the steam on, overwhelms the smaller machine, and the whole train is overthrown. It is scarcely possible to regulate this unity of action, more especially in the locomotives of unequal size and construction. Why are engines propelling from behind objected to? Evidently because, in the event of any obstacle occurring in front, a simultaneous check cannot be given to the rear engine, and it drives the carriages forward upon each other, at the very moment when the opposite effect is required.

There is, therefore, quite sufficient to account for the accidents in both cases, without raising the ridiculous and exaggerated cry against the four-wheeled engine *per se*. As respects safety to the travelling public, I believe, and I venture to say, in common with a great many engineers who are not manufacturers, that there is no material difference between the four-wheeled and the six-wheeled locomotives ; but that the consideration most generally influencing the selection is that of the distribution of the weight of the machine, so as to impinge less injuriously on the rails ; and it is well understood that the system of the double trucks, or eight-wheeled supports for locomotives, tenders, &c., as adopted on the American Railways, has been introduced on this principle, the rails and upper works in that country being in general much lighter than with us.

The real and important point, and which seems to have been quite lost sight of in the vivacious discussions on what I would call the minor question of the number of wheels, is, whether the *cranked axles* for the driving wheels of locomotive engines ought not to be abandoned, and whether driving axles should not be always made straight. The extent of prejudice in favour of cranked axles is most extraordinary. The very great increased expense incurred in making and strengthening them, the additional complexity and cramping into narrower space of all the moving parts of the machinery, and the consequent wear and tear and inconvenience involved by their use, to say nothing of the augmented risk, far overbalance, in my opinion, any theoretical advantages alleged in their favour, but which advantages and superiority, in practice, over the straight axle engine, I could never discover and wholly deny. Eight years since, after a hard struggle with the manufacturers, straight driving axles were adopted for the locomotives on the Dublin and Kingstown Railway. On that line, especially on Sundays and on holidays, the traffic is quite equal to that on any railway yet open. Trains of from 12 to 15 carriages (but with one engine only) are at such times sent every quarter of an hour from each end of the line ; and there has been no instance of accident from any cause connected with the form of engine or axle, or with such frequent departure of heavily laden passenger trains ; and the finance accounts of the Company show that the cost of locomotive power, repairs, &c. is below that of other lines using cranked axles ; nor do I know of any cause of objection to the straight driving axle, after seven or eight years experience of their use, without, I believe, a single instance of failure which fully justifies my opinion of their superiority.

On other railways I have been connected with I have not always been so fortunate as to have succeeded in banishing the cranked axle. As sometimes happens in Governmental and political struggles, the votes of the controlling body have overpowered the opinion of the executive, where a difference among members of our profession have given opportunities for Directors to exercise their own discretion ; and cranked or straight axles, four-wheeled or six-wheeled engines, have been alternately adopted according to the prevailing ideas of the majority of the several railway boards.

I have, however, reason to believe that several engineers of high standing are becoming converts to the straight axle, and I congratulate the public on it, as a very important step in the right direction.

In respect to the attention to be given to the manufacture of axles, it is impossible to pay sufficient regard to the importance that the scrap iron should not only be of very good, but also of exactly similar quality, and that each scrap should have gone through the same processes in its previous different stages. On this subject I hope some of the experienced manufacturers who are present will throw some light, especially on the details, for on the abstract principle there can be no dispute, although I suspect it is greatly neglected, in particular for ordinary carriage axles, and probably only scrupulously attended to in forming the driving axles of locomotives.

Some of the French engineers, however, have, within a very recent period, *suggested that* we must seek for the causes of the often unexplained rupture of axles in another way. M. François and Colonel Aubert have both lately read, at the Royal Academy of Paris, papers on the subject, and attribute the cause of the fracture of the axle of the engine on the Versailles Railway to the iron having been crystallized from the action of heat or magnetism. In support of this opinion it is stated that the axle broken was formed of the best iron, and was of sufficient dimensions ; and that the fracture had a decided crystallized appearance : and I have indeed myself often observed the same character in broken axles, so much so as to induce me to fancy sometimes that they had been formed of cast iron.

M. François stated in his paper that he had made a long continued series of experiments, and had observed that a magnetic action on iron in a state of fusion will produce similar effects, and change the small and closely adhering particles into coarse and large crystallized grains, depriving the iron of its compact character. This talented mineral engineer inferred that the action of heat upon axles moving at high velocities might produce the same effect. Both M. François and Colonel Aubert seemed to be of opinion that the only real precaution was to change the axles of locomotive engines so frequently as not to give them time to undergo the crystalline change ; suggesting, however, that iron that had been previously worked up should alone be employed for axles, and not new iron, which had more of a vitreous character, and was more susceptible of crystallization.

Since this paper was prepared, I have reason to believe that this crystallization of wrought iron has been noticed by some of our eminent manufacturers, whose opinions there may be an opportunity of obtaining ; and if it be, as Mr. Fairbairn informs me, that cold swaging will crystallize hammered iron, the shocks that locomotive engines sustain in their rapid transits may well be put as a great cause of this remarkable change.

It is, however, clear, that to remedy and replace straight axles is much easier and cheaper than to deal with cranked axles, and I venture to state it as my humble opinion, that as much ingenuity and talent is thrown away in arranging locomotive engines with cranked axles, and in perfecting the manufacture of those "crooked billets," as there was in rolling iron into undulations for fish-bellied rails ; which are now almost as much forgotten as, I doubt not, the cranked axles for locomotive engines will one day be.

Remarks.—Mr. Hodgkinson was certain, from the results of his experiments, that a succession of strains, however slight, would produce a permanent deterioration of the elasticity of the iron.—Mr. Fairbairn had been told by the engineer on the Leeds line, that he considered all crank axles to be constantly deteriorating from percussions, strains, &c., and that they should be removed and replaced by new ones periodically, to avoid danger of fracture.—A discussion arose as to whether the crystallized appearance observed in fractured axles arose from defects in the manufacture, in the quality of the iron, or from the effects of working, either by percussions, strains, or magnetic action. —Mr. Grantham, although a manufacturer of cranked axles, admitted that straight axles were less liable to break. Cranked axles, from the way in which they were welded together and shaped, were rendered weak and liable to fracture. On other grounds, however, he believed that the cranked axles were preferable, as they produced a steadier motion, and much heat was saved.—Mr. Garnett believed that more straight axles had broken than cranked ones.—Prof. Willis showed the effect of vibration in destroying molecular arrangement, by reference to the tongues in musical boxes, &c.—Mr. Nasmyth believed that the defects in axles, &c., arose in the manufacture, especially from cold swaging and hammering, and also from over-heating in welding, all of which causes injured the toughness of the iron. In small articles he found great advantage from annealing ; and he believed that axles might be annealed very cheaply, and would be more serviceable. He disliked the fashion of referring all unaccounted phenomena to magnetism and electricity, although he was convinced that very singular electric phenomena accompanied the transit of locomotives and the rapid generation of steam. With this was connected the non-oxidation of rails, where the traffic was in one direction, and the rapid oxidation when the same rails were travelled over in both directions, as in the Blackwall railway. He had also observed that brasses, in some cases, had from friction entered into *cold fusion*—that is, at a heat not perceptible to the eye, a complete disintegration of the molecular structure had taken place, and he had seen the brass spread as if it had been butter or pitch. He had no doubt that this arose from electricity, but had not ascertained the fact from experiment.—Mr. Fairbairn stated, that in hand-hammered rivets the heads frequently dropped off, and presented a crystallized appearance, while those compressed by machine were sound. He found that repeated percussions, from the rivetting, hammering plates, &c., induced magnetism in iron boats.—Mr. Vignoles could not, from his experience, agree to Mr. Nasmyth's theory of the oxidation of rails by single traffic, as the railway from Newton to Wigan had been single for a long time, and was as bright as the Manchester and Liverpool. The Blackwall railway was not an analogous case, as no locomotives were employed.—Mr. Roberts disbelieved the deterioration of axles by work ; he would rather trust an old axle than a new one. He believed cold swaging and hammering to be the chief causes of mischief. In fact, if axles were sent out sound and well manufactured, they would rather improve by working.

Mr. Nasmyth at a subsequent meeting gave some valuable practical suggestions on the cause of breaking of axles, which we purpose noticing next month.

On the Action of Air and Water on iron. By Mr. Mallet.

This is the third report for which the association is indebted to Mr. Mallet. The object of former tabulated results was to determine the actual loss by corrosion in a given time, and the comparative durabilities of rust of the principal kinds of cast iron of Great Britain, and to discover on what durability depended. The tables of experiments now presented show that the rate of corrosion is a decreasing one in most cases, and that the rapidity of the corrosion in cast iron is not so much dependent upon the chemical constitution of the metal as upon its state of crystalline arrangement, and the condition of its constituent carbon. The present report, too, extends the inquiry to wrought iron and steel, of which between thirty and forty varieties have been submitted to experiment. The results show that the rate of corrosion of wrought iron is in general much more rapid than that of cast iron or of steel. The finer the wrought iron is, and the more perfectly uniform in texture, the slower and the more uniform is its corrosion. Steel corrodes in general more slowly, and much more uniformly, than wrought or cast iron. The results of the action of air and water in the several classes of iron have been examined and chemically determined. The substance spoken of as plumbago was next described. It is produced by the action of air and water on cast steel, especially that in the raw ingot, in the same way as it is in the case of cast iron.

A quantity of plumbago, found in the wreck of the *Royal George*, absorbed oxygen on exposure to the air with such rapidity, that it became nearly red-hot. Mr. Mallet next described a method of protecting iron by a modification of the zinc process. It was found impossible to cover the surface of iron with zinc, to which it had no affinity. The first process was to clean the surface of the iron, taking off the coat of oxide, and then immersing it in double chloride of zinc and ammonium, which covered it with a thin film of hydrogen, by which its affinity for the zinc is much increased. The iron was then covered with a triple alloy of zinc, sodium and mercury. Mr. Mallet produced several specimens of his alloy, one of a bolt to be driven into a ship's side, and another a cannon shot covered with his preparation, and exposed to the weather on the roof of a building, and which was perfectly preserved. Cannon balls were so much oxidised by exposure to atmospheric influences, that in five or six years they became useless. The French Institute had been engaged in experiments to protect these, and had been compelled to abandon it. Mr. Mallet also brought under the notice of the section a method of preventing the fouling which takes place on the bottoms of iron ships, especially in tropical climates, by means of which new invention he had ascertained plants and animals were prevented from adhering to the ship's bottom.

Another series of experiments related to the rate of corrosion of cast iron, wrought iron, and steel, exposed to atmospheric influences—a matter of great importance to the engineer. The characteristic form of corrosion in air, as contradistinguished from that of water, was also pointed out. This series of inquiries was now complete. The next matter which had engaged his attention was the rate of corrosion of rails on railways. The general opinion was, that the rails travelled over were not corroded at all. He had been enabled to lay down three sets of rails on the Dublin and Kingstown Railway: one not travelled over, the second in use and not exposed to corrosion, and the third also in use, but made impervious to moisture. The loss of the first was 2·555, of the second 2·344, and of the third 2·650,—results which seemed to indicate that the rail travelled over does corrode more slowly than that out of use. Mr. Mallet concluded by referring to Mr. Nasmyth's theory, that corrosion is checked by the trains passing over the rails always in one direction, and takes place when, as in the case of the London and Blackwall, trains pass both ways.

The Vice-President paid a high compliment to Mr. Mallet on the value of his investigations, and the success which had attended them. The cost to the association of these inquiries was far less perhaps than that incurred by Mr. Mallet in addition to the sum voted him; while the results might have been made more conducive to his private purposes, had Mr. Mallet chosen to conduct them for his private advantage. In reply to a member, Mr. Mallet said his preparation for the bottoms of iron vessels lasted for about two years and a half in Kingston harbour, in a vessel exposed to a rapid tide-way. He did not think his preparations would answer for copper sheathing. Nothing but copper would protect wood; but he looked forward to the time when the greater proportion of our vessels would be constructed of iron.

"*On the mode of conducting experiments on the resistance of air.*" By Mr. Eaton Hodgkinson, F.R.S.

Mr. Hodgkinson said, that, having been honoured by the Association with a request to pursue some experiments on the resistance of the air, he was desirous of exhibiting an instrument prepared for making the first series of these experiments. He proposed, in the first instance, to seek for the force of the wind moving at different velocities, upon plane surfaces of given dimensions, these surfaces being either perpendicular, or inclined at any angle, to its current; to determine this, he intended to place the apparatus upon the front of the first carriage of a railway train; the road along which the train passed having for a short distance poles stuck up, one hundred or two hundred yards asunder. He would try the experiment only on days when there was no perceptible wind; and then, if the time in seconds, taken in passing between two poles, be carefully observed, and the pressure indicated upon the discs (which were of two feet and four feet area, both round and square), the resistance per square foot, with a given velocity, would be obtained. He hoped to determine these facts, with various velocities and at different angles of inclination in the discs, trying the same experiments with both discs at the same time, to ascertain whether the resistance to a square surface and a round one, of equal area, was the same, and that the results might correct each other. It would then be determined how far the law of resistance of air to planes moving obliquely through it agreed with the theoretical suppositions hitherto in use. To apply the result of the proposed experiments to the case of bodies at rest, acted upon by the wind, he assumed that the resistance of a body moving with a given velocity through the air at rest, was the same as that of the wind moving with the same velocity, and acting upon the body at rest. The directors of the Manchester and Birmingham Railway had kindly consented, at Mr. Buck's request, to allow him to make these experiments; and he was indebted to Mr. Fairbairn for the apparatus,—This was placed on the table. It consists of two discs of wood (which may be round, square, or of any other form), made inclinable to any angle, by means of screws that fix them to their position, and having two straight rods moving in slots, and an attached quadrant to measure the angle. To ascertain the force of the wind, one of Salter's balance springs is placed behind each disc, attached to the cross piece which connects the two rods of the discs; and this indicated the force of the wind at any moment. Several suggestions were made as to the instrument, and the mode of trying the experiments; to which Mr. Hodgkinson said he would give every consideration.

Experimental Inquiries on the Strength of Stones and other Materials. By Mr. Hodgkinson.

After noticing the present state of knowledge on this subject, and the experiments of Barlow, Rennie, and of other experimentalists on the continent, Mr. Hodgkinson said he had long felt anxious to ascertain how the three forces—the crushing, the tensile, and the transverse strength—and the position of the neutral line—(that separating the extended and compressed fibres in a bent body)—were connected in bodies generally; and his experiments had for several years been directed to discovering facts upon each of these matters, in order to determine the question. His experiments some years ago, made for the British Association, with respect to the values of hot and cold blast iron, had shown that the ratio of the forces of ultimate tension and compression was nearly constant in all the species of cast iron; and a few experiments made at that time on sandstone and marble, had led him to suspect that nearly the same would be the case in these and other hard bodies. Through the liberty of his friend Mr. Fairbairn (who had, as usual, given him every assistance his establishment afforded), he (Mr. Hodgkinson) had made a great many experiments upon wood, sandstones, marbles, glass, slate, ivory, bone, &c., to ascertain the tensile, crushing the transverse strength of each; also, as far as possible, the situation of the neutral line in thirteen different kinds of timber (including oaks, pines, teak, &c.) All the three sorts of experiments were made as far as possible out of the same specimen in each case, to render the results as unexceptionable as they could be made. The wood was of good quality and perfectly dry, having been chosen for this purpose, and laid in a warm dry place for four years or more. Previous to experiment, the bars of wood were all reduced with care to the same dimensions, and afterwards weighed, to ascertain the specific gravity. They were then laid upon supports to obtain the deflections with given weights, and the breaking weight with its deflection. The two portions into which a specimen was broken were afterwards reduced in the middle by the lathe to the form used in Mr. Barlow's experiments, in order that the experiments might be torn asunder in the middle, by a force acting directly through the axis, and thus to obtain the tensile strength of the wood. Afterwards, the thick ends of the specimens were turned by the lathe into cylinders, all of the same diameter and length, as nearly as practicable, and their exact dimensions afterwards taken, in order to ascertain by experiment the resistance of the woods to a crushing force. After describing the character and results of his experiments on the various substances named above (specimens of which he produced), Mr. Hodgkinson gave the following summary of results of very numerous experiments on marbles and stones of various degrees of hardness:—

	Crushing force per square inch called 1000.	
Description of stone.	Tensile force per sqr. inch.	Transverse strength of bar 1 inch square, and 1 foot spaces.
Black marble	143	10·1
Italian marble	84	10·6
Rochdale flagstone	104	9·9
High Moor stone	100	
Stone called Yorkshire flag		9·5
Stone from Little Hulton, near Bolton	70	8·8
Mean rates	100	9·8

Mr. Hodgkinson gave the following recapitulation of results:—Calling the mean crushing strength per square inch, in the different articles experimented upon, 1000, we have—

	Tensile strength.	Transverse strength.	Ratio of mean transile to one strong force.
In timber	1900	85·1	1·55
Cast iron	158	10·8	1·66
Glass (plate and crown) ..	123	10·	1·78
Stone and marble	100	9·8	1·105 or 1·89, taking the hardest only.

The ratio of the crushing force to the transverse force is nearly the same in glass, stone and marble, including the hardest and the softest kinds. Hence if we know the transverse strength or the crushing strength in any of these bodies, we may predict the other; and, as glass and the hardest stones resist crushing with from seven to nine times the energy that they do being torn asunder, we may get an approximate value of the tensile force from the crushing force, or *vice versâ.* These results render it probable that the hardest bodies, whether cast iron, glass, stone, or marble, admit of certain atomic displacements, either in tearing asunder or crushing, these displacements being in a given ratio to each other, or nearly so. In future calculations as to the strength of bodies, the crushing strength ought to be made the fundamental datum, which I have recently done, for the reasons shown in this notice. The ratio of the transverse strength to the crushing strength is greater in cast iron than in glass, marble, and sandstones, arising from the ductability of that metal. The necessity of enlarged inquiries in these matters will be seen, when it is reflected that calculations of the transile strength of cast iron, or marble, or stones in general, made from the transverse strength by the modes used by Tredgold, Navier, and others, give the transile strength twice or three times as great as it ought to be.

The Chairman said the section was greatly indebted to Mr. Hodgkinson for his very interesting communications. Those experiments had attracted much attention from scientific men, and the Royal Society had presented him their medal for a former paper on this subject. [We may here mention, that this communication was only some portion of a more full and perfect paper, to be read before the Royal Society; such communication being now made only as would not preclude Mr. Hodgkinson from laying the more complete results before that society.] He might also express the opinion of practical men, that no experiments, either as to extent, care, or accuracy of observation, gave results at all comparable in point of value with those of Mr. Hodgkinson, who, he hoped, would have the time and inclination to pursue his experiments to a greater extent. There were no results in practical science of greater importance than those which showed us the strength and stability of materials. In the structure of buildings, upon which the comfort and wealth of so many individuals depended, and in other structures in engineering operations—an ignorance of the important facts arrived at by Mr. Hodgkinson had, in many cases, led engineers to make structures disproportionately strong or weak; in the one case causing unnecessary waste of materials and unnecessary expense, in the other periling the stability of the structure, and the safety and lives of those within it.

The Rev. Dr. Peacock (Dean of Ely) then made an oral communication "*Upon the report of the commissioners for the restoration of lost standards of weights and measures, and upon their proposal for the introduction of a decimal system*" (during which communication Sir William Hamilton took the chair). After stating that the imperial standards of weights and measures (the yard, the lb., the gallon, and several of their multiples) had been lost in the fire which destroyed the two Houses of Parliament, he said that a commission (of which he was a member) had been appointed, to report on the best means of restoring these standards. He noticed the proceedings of a former commission, on whose recommendation the act of the 5th Geo. IV. had been passed, declaring the imperial standards of weights and measures, and prohibiting all others to be used, and pointed out the erroneous data on which that former commission had fixed the standard yard; by which data, therefore, the present commission did not recommend its restoration, but rather to take the extant copies of it, especially the one in the care of Mr. Francis Baily, as the authority upon which the new standard yard should be formed. The commission also recommended to the government that the standards of length and weight should be independent of each other, which was not the case before. The standard pound weight was Troy weight (5780 grains), though the pound avoirdupois (7000 grains) was used throughout the country, in the proportion perhaps of 10,000 to one of Troy. The commission recommended the standard pound to be the representative of the avoirdupois, and not (as before) of the Troy pound; that, hereafter, the use of the Troy pound should be abolished, except for a very limited number of transactions, and that the avoirdupois pound should be considered as the standard pound of Great Britain. They recommended that measures of capacity should be determined by measures of weight—by far the most convenient method, inasmuch as weighing was a much more accurate operation than, for instance, the formation of a perfect cube. The commission also ventured to recommend strongly some alterations in the coinage, and the systems of weights and measures, arising out of a more extensive introduction of the decimal scale. The nearly unanimous determination of the commission was, that any attempt to interfere materially with the primary units of the coinage, weights, and measures, in ordinary use, would produce such confusion and bad consequences in the ordinary transactions of life, that they would adhere strictly to all those primary units, viz., the pound sterling of our coinage, the yard, in the measure of length (and also the foot, for there were two primary units in this measure), the acre, in the measure of areas, the gallon, in the measure of capacity, and the imperial pound in the measure of weight. As the coinage must necessarily be the basis of any changes leading to the more extended adoption of a decimal scale—taking the pound sterling as the primary unit, they proposed to introduce a coin of the value of 2*s.* (one-tenth of the pound); another, either silver or copper, of one-tenth of 2*s.* (or 2*d.* and a fraction) which might be called a *cent* (the hundredth of a pound); and the thousandth part of the pound sterling, or nearly the value of our farthing (of which there are 960 in the pound), which new coin it was proposed to call a *millet* (from thousandth). The difference in the value of the copper coinage was less important, as it was merely a representative coinage, and had not an approximating intrinsic value, like the gold and silver coinage. For the proposed coin of 2*s.* various names had been suggested, as *Victorine*, rupee, or florin; it being not much different from the value of some of the rupees of the East Indies, or the florin of the Continent. Under this new decimal scale the shilling would be retained, and also the sixpence (but the latter under another name, more representative of its value). For the half-crown would be substituted the 2*s.* or *Victorine.* The very rev. gentleman dwelt at some length on the advantages of this change, in the extensive money transactions and accounts of bankers and merchants; in the Bank of England, for instance, where a thousand clerks were employed, where it would greatly facilitate the operations of calculation and book-keeping. Thus, discarding *millets* (for bankers now excluded the subdivisions of a penny in their accounts), the sum of £17 3 *Victorines*, 7 *cents*, would be represented at once by 17·37; only two places of decimals, instead of as now in pounds, shillings, and pence. He showed how the principle was applicable, with still greater advantage, in cases of weights and measures (where the scale was now most anomalous and absurd). Suppose the rental or value of 30·64 acres of land to be required, and that the land cost £69 3 *Victorines*, 4 *cents.* an acre. The reduction in common arithmetic was one of very considerable labour, difficulty, and time. Indeed, if this decimal system were adopted, the labour of teaching arithmetic to school boys would be reduced nearly one half. But by this plan (as the rev. doctor showed), the result might be obtained in five lines of decimals, containing only 21 figures. As to weights, the most extensive change recommended by the committee would be to introduce the uniform weight of 10 lb. to the stone, instead of the varieties of 8 lb. in some, and 14 lb. or 16 lb. in other parts of the kingdom; the hundred weight to be called *centna* (a German term). There were all the changes proposed in weights, the commission not wishing to interfere with the subdivision of the pound, which admitted of four subdivisions into 8 oz., 4 oz., 2 oz., and 1 oz. The pound and ounce would remain, therefore, exactly the same as at present. As to the measure of length, the commission thought it too violent a change to alter all the milestones; but there would be no difficulty (with reference to the standing orders of parliament, in railway matters, &c.) to introduce the measure of 1000 yards, which might be called a mil*yard.* However, the commission made no recommendations as to nomenclature, leaving that to the legislature. Thus the changes proposed to be introduced, not only to ensure a decimal coinage, but a decimal subdivision of weights and measures, were by no means of that formidable and appalling character which many persons supposed they must of necessity possess.

On the use of Beton and Concrete in the construction of Breakwaters.

Mr. Vignoles called the attention of the section to the works now going on at Algiers, in the formation of breakwaters by the use of concrete, under the direction of M. Poirel, where he said a shelter had already been made for 15 sail of the line, at an expense, even under all the difficulties presented by the circumstances of that country, of about 20*s.* per cubic yard; and he had no doubt that in this country, in any situation where a good hydraulic lime could readily be procured, the expense would not exceed 10*s.* per cubic yard. Some very extensive works of the same kind had also been executed at Marseilles. Mr. Philip Taylor, of Marseilles, in confirmation of Mr. Vignoles, mentioned several instances in which concrete was used in that neighbourhood, with the greatest success. He stated that *béton* was a material much used in that vicinity, though scarcely known in England. It was composed of one part of ground brick, and two parts of lime. Mr. Smith, Mr. Fairbairn, and several other gentlemen, expressed their opinions as to the value of concrete, and its applicability to a variety of purposes to which it was not commonly applied.

Mr. Scott Russell's Index for the speed of Steam Vessels.

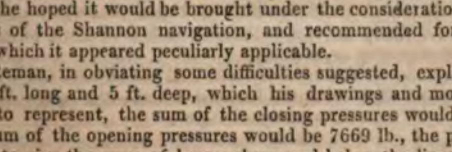
Mr. Russell stated, that his index of speed was founded on the well-known dynamical fact, that if an aperture were made in the lower part of a vessel containing water, and a stream were allowed to issue from it against an aperture in another vessel containing water, the force of the current would keep the water in the second vessel at the same height as in the vessel from which the current issued. It would follow, from this principle, that if a vessel were passing through the water at a speed equivalent to that of the current produced by a given head of water, the resistance would raise water in a tube inside the vessel, but subjected to the action of the external fluid. Mr. Russell then proceeded to detail the particulars of the invention to which he had applied this principle, by passing a tube through the bow of the vessel, and carrying it along the flooring to the centre of gravity of the vessel, where it terminated in a vertical glass tube, exhibiting the weight of water within. To this tube there was attached a moveable scale, the zero of which being placed on a level with the point at which the water stood when the vessel was at rest, the rise of the water in the tube when the vessel was set in motion exhibited the velocity at which the vessel was passing through the water. With the view of testing the accuracy of this invention, he had tried it repeatedly over a distance of 15 miles, measured trigonometrically. He had also compared it with the best logs, and was perfectly satisfied of its accuracy. From these experiments he had constructed a scale, which he exhibited, and of which the following is a copy; the first column exhibiting the speed in miles per hour, and the second the height of the water in the tube above the zero line expressed in feet and decimal parts:—

Miles per hour.	Feet on the scale.
15	7·5625
14	6·5880
13	5·6800
12	4·84
11	4·067
10	3·36
9	2·722
8	2·151
7	1·647
6	1·21
5	0·84
4	0·537
3	0·3025
2	0·134
1	0·0336

A NEW SELF-ACTING WEIR AND SCOURING SLUICE, by Mr. Bateman.

Mr. Bateman observed that the great objections to fixed weirs and dams were, that by causing a partial stagnation in the water above them, they allowed the bed of the stream to be silted up by the deposition of mud, gravel, &c., whereas the proposed weir would adjust itself to the various changes in the condition of the stream, and prevent any filling up of the channel by making the stream clear itself. Mr. Bateman's weir is composed of two leaves turning horizontally on pivots, which are placed below the centres of the leaves, so that the upper portions of them shall be of much greater area than the lower. The upper leaf is also far larger than the lower, and turns in the direction of the stream; while the lower leaf turns against the stream, and overlaps the bottom edge of the upper leaf, and is forced against it by the pressure of the water. The comparative area of the leaves and position of the pivots is so arranged, that in ordinary states of the stream the tendency of the current to turn over the top leaf is counterbalanced by the pressure of the water against the overlap of the bottom one, the counteracting pressures keeping the weir vertical and the leaves closed, the water flowing as usual through a notch in the upper leaf. But when the water rises above the usual level, the pressure above, from greater surface and leverage, overcomes the resistance below, and the top leaf turns over, pushing back the lower leaf, and thereby offering the least possible obstruction to the water, and giving a passage at the very bottom of the stream to the gravel or mud.

The following diagrams will explain the construction of the weir:—



In answer to questions and objections, Mr. Bateman explained how difficulties, arising from trees floating down, the complete turning over of the leaves, &c., might be obviated by suitable stops, grating, &c.—Sir J. Robison observed, that the Rotterdam Canal had weirs on a similar principle; but Mr. Bateman explained that those weirs turned vertically on their axis. Mr. Vignoles stated, that from the cheapness and apparent advantages of this weir, he hoped it would be brought under the consideration of the Commissioners of the Shannon navigation, and recommended for trial on that river, to which it appeared peculiarly applicable.

Mr. Bateman, in obviating some difficulties suggested, explained that, in a weir 20 ft. long and 5 ft. deep, which his drawings and model might be supposed to represent, the sum of the closing pressures would be 7956 lb., and the sum of the opening pressures would be 7669 lb., the pivots being so placed as to give the areas of leaves above and below the lines of their axes the ratio of 2 to 1. The leaves would consequently be kept close by a force equal to the difference between these pressures; that is 287 lb. As the water rises these conditions would, however, be changed. Supposing the water to rise one foot, the additional pressure would be 1200 lb., of which 800 lb. would be exerted in opening, and 400 lb. in closing the leaves; and the result would be that the sum of the opening pressures would exceed that of the closing by 100 lb. The leaves would consequently be opened. He also explained that the sills against which the gates are made to close, might be so regulated as to discharge the greatest flood of water without allowing the leaves to open more than a moderate quantity; but, if thought necessary, the gates ought to be allowed to assume a position perfectly horizontal in cases of high floods, and thereby oppose the least possible resistance to the passage of the water. The sluice might also be protected from being choked with trees and brushwood floating down the stream, by means of a grating.

Mr. Liddell read a paper *on Ventilation, on a method proposed by Mr. Fleming, of Glasgow.* It had been tried in a large building occupied by a number of poor persons, each family having a room. From the unclean and intemperate habits of the inmates, and their number (about 500), the house was very unhealthy, and many deaths from contagious diseases took place. In the plan adopted, the galleries were traversed by pipes of nine inches diameter, which united in a vertical pipe of large dimensions communicating with a lofty engine-house chimney; and small pipes of one inch diameter, at the top of each room, communicated with the pipes in the gallery. This plan had also been tried in the Glasgow Fever Hospital, in which the beds for fever patients, &c. were fitted up with the tubes for carrying away noxious effluvia. A similar plan for the ventilation of ships and steamers had been introduced by Dr. Reid, by leading tubes from the berths into a stove on deck, or, in steamers, into the chimney. Mr. Liddell stated that the expense for a house of 60,000 cubic feet was only 40 lb. of coal in twenty-four hours.

Sir J. Robison remarked, that from his experience the plan of Mr. Fleming, as far as regarded the size of the pipes, was inadequate.

ON THE ACTION OF LIGHTNING CONDUCTORS.

At the meeting of the Electrical Society on Tuesday evening, 19th July, a paper on this subject by Mr. Charles Walker, the Secretary, was read. The author entered into a very close investigation of the most important experiments that have been adduced in illustration of the nature of these instruments; and stated that discharges of Leyden batteries have been very generally selected as representatives of lightning flashes. He then showed the great difference between the visible character of the two flashes, and analyzed the cause on which each depends; demonstrating that the only case in which the resemblance is in any degree to be traced, is when a Leyden discharge fractures the glass, and passes directly between the coatings; and that in all other cases the said discharge is the result of two forces acting counter to each other. Thus he reaches his first conclusion, that the discharge of a Leyden jar does not resemble a flash of lightning; and therefore that Leyden jars should not be employed in these experiments. He then said that many points on which philosophers of the present day differ, are in connexion with the results of the Leyden experiments; and hence, if it can be shown that these experiments ought to be excluded, the at present complicated inquiry will be much simplified. He proceeded to trace the close resemblance between the discharge of a prime conductor and a cloud, illustrating his opinion by the aid of the magnificent machine belonging to the Polytechnic Institution; and showed that experiments with this conductor are in all essential points legitimate. He then described an extensive series of experiments to prove that a wire on which sparks are thrown from the prime conductor represents a lightning-rod; and then that sparks will pass from such a wire, and therefore from a lightning-rod, to vicinal conducting bodies. This last position was illustrated in a general manner by an assistant holding in his hand a glass rod surmounted by a brass ball; the ball was connected by stout wire with the gas-burners of the room, and thus when sparks were thrown on it from the conductor the electricity passed into a good discharging train to the earth. Now, while this took place, the application of a piece of metal to any part of the wire produced a spark; and not only so, but the same could be obtained from any of the gas-burners in any part of the room; and even when the writer descended into the workshops, two stories below the machine, sparks could be obtained from the burners there, which were indeed very much out of the direct line of circuit, so great is the desire of the electric current to use a wide path. This is the source of danger alluded to in the paper on Brixton church, reported in the last *Journal*. However, as the wires in this, as in several other similar experiments, were not directly between the conductor and the earth, the following arrangement was made, which answers every condition, and the general result of which proves that the wires above described do act as lightning-rods. Attached to the prime conductor of the machine was a thick brass rod, terminating in a five-inch ball; immediately beneath this was erected a similar rod surmounted by a ball. This rod was screwed into a small brass disc on the floor, and was considered a perfect representation of a lightning-rod, when sparks or flashes were passed into it. Near this a shorter and smaller rod (also terminating in a ball) was held; when the end of this rod touched the brass disc, no sparks passed between the two, when it did not touch, sparks passed in abundance. Much of the value of the inquiry was shown to depend on this experiment. If the former state of things represents what occurs in nature, there is no danger of a lateral spark; but if the latter, the danger is great. That metallic contact in this experiment prevented the appearance of sparks is an experimental proof of the safety resulting from the metallic connexions formerly recommended. These latter re sults are given in explanation of the well-known experiment of the two metallic discs; and Mr. Walker shows that no lateral discharge takes place between these discs, because the vicinal metal is in contact with the lower disc. While, therefore, the author agrees in recognising the value of lightning-rods, he has strong reason to believe that this lateral spark will occur unless proper precautions are taken; and though he differs in some degree from others, he does so in a feeling of perfect good-fellowship, and expresses a willingness to forsake his opinions whenever they are shown to be untenable. He states, in conclusion, that even if he is in error, still science will have gained something; for the received opinions will then have been able to withstand another assault, and will only stand the firmer.

IMPROVEMENTS IN LIVERPOOL.—ADVANCE OF ARCHITECTURE.

It has long been a subject of regret to men of refined and cultivated minds, that the architecture of our towns displays a miserable degeneracy from the purity of ancient taste. This degeneracy was perhaps to be expected. The state of the fine arts is determined by laws exactly the reverse of those which regulate the progress of the useful arts and mechanism. As, therefore, these have advanced, so has architecture declined. Elegance and chastity of design have been too often sacrificed to utility and economy; and the profession of the architect, which in Rome or Athens could claim the patronage of Augustus or Pericles, has in modern times received little encouragement from the great and powerful. But within these last few years a light seems to have been gradually dawning, which, we would fain hope, will reflect back something of the splendour of ancient days. Men of rank, of education, and refined taste, have applied themselves to a study which was before often degraded by the influence of ignorance and vulgarity. Architecture has rapidly advanced and a pure style is taking the place of a barbarous and confused medly of ancient and modern conceptions.

Perhaps our town of Liverpool is the best example we can bring forward to illustrate these remarks. The stranger must view with admiration, and our fellow-townsmen with pride, the taste and judgment displayed in the designs of many of our recent buildings. St. George's Hall and the New Collegiate Institution, for both of which we are indebted to the talent of Mr. Elmes, cannot receive too great commendation.

We purpose to furnish, from time to time, notices of the principal new buildings that may rise up amongst us, with a view to encourage the more general cultivation of a refined taste in Architecture, and shall on the present occasion commence with

BRUNSWICK BUILDINGS.

We have been much struck by a visit to this structure, now nearly completed, in Brunswick-street, and we are sure our readers will be gratified by a description of its chief characteristics. It has been constructed in the palatial style of Italian Architecture, presenting massive, unbroken façades towards Brunswick and Fenwick-streets; the rusticated basement is partially elevated above the street, and forms a substantial stylobate to the superstructure. The ground story is channeled between the windows, and surmounted by a Doric entablature, which runs entirely round the building, forming a band on which are set the windows of the first story; these windows are crowned with segmental pediments supported on appropriate trusses, whilst those on the story above have their pediments of the usual angular form. The main cornice, the most prominent feature in the design, projects three feet five inches from the face of the wall, and, in addition to the usual combination of mouldings. has modillions of a novel character; a-frieze below is enriched with scrolls contained within panels. The quoins at each of the angles exhibit a variety in workmanship, and increase in solidity as they approach the ground. Throughout, simplicity appears to have been studied, and breadth of effect has been obtained, not so much by vertical breaks or superfluous ornament, as by adhering to what is termed "the horizontal line in architecture."

The entrances are in Brunswick-street, and form a centre-piece of three semicircular arches, filled in with bronzed perforated doors. one of which leads to a handsome court-yard. This court is entirely covered with glass, and affords light and access to the interior. The building is fitted up with sets of offices, arranged so as to meet the wants of every description of tenant, whose comforts appear to have been studied in every minute particular.

The whole building is of fine free-stone—that of the ground story of a light reddish tint, and all above it of white. Viewing both fronts from the opposite corner of Fenwick-street, a little higher up, it presents a very beautiful and striking appearance, from its general uniformity, or strict keeping in design, the richness of the cornicing and mouldings, and the chasteness of the ornaments—none of which are superfluously introduced. The great number of windows gives it also an air of liveliness rarely attained in commercial structures. Of these there are twenty-seven in three rows in the façade to Fenwick-street, which is the longest; and eighteen in that to Brunswick-street, in rows of seven in the two upper stories; and with four below—two on each side the two doors, between which is a handsome perforated window, making the apertures uniform in position. The arches over the doors and window between, we should add, have ornamental keystones carved in classical heads in full projection.

The covered court in the interior of the pile is an oblong square, with two ranges of galleries on each side, running longitudinally, and across the north end; and forming open and cheerful passages to the several offices above. These galleries are fronted with handsome massive balustrades or railings, each of a different but strictly classical design. The lower portion, or basement of the immense sky-light over head is of a segmental, or rather ogee form; and the centre is elevated some feet over the higher point of each segment, by light frame-work, which forms a continuous range all round of small perpendicular arched openings, affording ample ventilation. The sloping glazed roof on each side and at the ends (in pavilion form) overhangs this ornamental open-work—so that the rain cannot enter excepting in very high winds, and even then but slightly. There is an ornamental semi-circular projection at the south end of the court—within which is a spiral additional staircase. The appearance of this court, whether seen from below, or from any part of the galleries, is at once novel and palatial—the top resembling a conservatory. It is, indeed, a principal feature in the building, and has already attracted the attention and admiration of many visitors. The court, and the galleries, are smoothly covered with asphaltum, and the latter have numerous perforated gratings of cast-iron on the same level, admitting additional light and air. There is a range of offices, water-closets, &c., in the attic, all round the four sides of the base of the large sky-light covering the interior square or court, with a wide passage open to the air, and fenced off, clear of the glass, by a light iron railing. This passage forms a pleasing promenade. The rooms at this elevation are lighted both from the sides and by roof-lights, and a few creeping plants of slender foliage trained here and there to the glass, so as to subdue and mellow the light required for the rooms below, are alone wanted to give the whole the appearance of a green-house surrounded by cottages. It may be added, that the mode of ventilation is so well contrived, that no additional heat is perceptible in the area below, even while the summer sun is shining brightly.

The interior arrangements of the building appear to be such as to ensure the utmost convenience. The stairs are easy, and all the rooms well lighted and airy.

The town is indebted to Joseph C. Ewart, Esq., for this structure. He has evidently given to Messrs. Arthur and George Williams, his architects, more scope than is usually granted to men of their profession on similar occasions; and they appear to us to have displayed a rare degree of taste and judgment in the design and completion of the building, which may undoubtedly be considered an honour and an ornament to the town. It cost £13,000, and covers 835 superficial yards.

CHAPEL-STREET.

In Chapel Street, two fine commercial buildings are in a state of progress—one nearly completed, and the other (adjoining the property of Messrs. Waterhouse and Sons) raised to the plinth. The latter, at the corner of Chapel Street and west corner of Old Hall Street, is of large dimensions; and as it is situated immediately behind the Exchange Buildings, in the centre of the commercial portion of the town, and in one of its principal thoroughfares, public curiosity may be gratified by a sketch of the design. We have been kindly favoured with a sight of the plans and elevations, by the architect, Mr. Culshaw; and the following description (drawn up on the supposition that it were completed, which it will shortly be) will be found to be pretty accurate:—

The building is in the Roman style of architecture, and each façade (fronting Old Hall Street and Chapel Street, respectively) consists of an attached pilastrade of the Corinthian order, from the temple of Jupiter Stator. It is mounted upon a rock-faced stylobate, crowned by a graceful attic, which dies into the pediment at the end. The principal façade, towards Old Hall Street, is pierced with six Venetian windows; and the end front, towards Chapel Street, contains three similar windows. These apertures are of large dimensions, being upwards of ten feet in width, and continued the whole height, from the basement to the entablature. They are each finished with an arch and an enriched key-stone, and are ornamented at the height of each floor with a neat panelled entablature, supported with light iron columns of the same order, set back from the face of the reveals. The space between the pilasters and windows are finished with sunk and channelled joints, which serve for the window dressings.

It is to be regretted that the corner of this noble building, at the junction of the two streets, is cut off at the height of the stylobate, for the purpose of public accommodation on the foot-walk; and this renders it necessary to introduce a truss to carry the angle pilaster, which produces a novel, but, we think, rather deteriorating appearance.

The interior arrangements are considered well adapted for the purpose for which they are intended—that of brokers' offices—the apartments being very roomy and well lighted.—*Liverpool Paper*.

FRESCO AND ENCAUSTIC PAINTING.

Mr. Simpson, the decorator, of West Strand, has devoted considerable attention to the subject of fresco and encaustic painting, in consequence of the opinions expressed in their favour by the late Committee of the House of Commons, and the encouragement which they appear likely to meet with from the present Commission. He has made several experiments on variou cements for the purpose of ascertaining their fitness as grounds for *orna* *mental* and *decorative* paintings, and under the direction of Mr. Latilla and other artists has produced specimens of each. Mr. Simpson has, in some instances, adopted the ground of lime and marble dust, according to the plan of the ancients, on which he has succeeded in fixing the colours, and preserving their intensity and brilliancy so well that even a copious and repeated washing has not removed them, nor materially diminished their effect. Still, he has of course been confined, on this ground, to the use of such pigments as *are not injured by lime.* But the greatest success has attended the use of the beautifully white and hard cement, known as *Keene's cement*, as manufactured by Messrs. White and Sons of Millbank, on which, when in a moist state, the colours are easily applied, and become, when dry, perfectly fixed; and it possesses the farther great advantages of admitting of the highest degree of finish, and allowing the use of those pigments which will not bear the mixture of lime. These specimens have been repeatedly washed with soap and water. The painting in encaustic and *a tempora* (which Mr. Simpson has been enabled to render permanent) on Keene's cement, when dry and even polished, has proved quite satisfactory; as the brilliancy and clearness of the tints, contrasted and thrown out by the whiteness of the surface, produces an effect superior to any other ornamental painting yet attempted. No doubt other materials will be introduced, but it is those above described to which Mr. Simpson's attention has as yet been principally directed.

REMARKS ON THE "PONT DU CARROUSEL," PARIS.*

Sir—I beg to rectify an incorrect dimension contained in your number for July, relative to the size of the centre arch of the Pont du Carrousel in Paris, and will, with your permission, take advantage of this opportunity to offer some few observations on the construction of this bridge, erected by me, according to the plans of M. Polonceau, whose merit as an engineer of high standing is considerably enhanced by the conception of this very elegant structure.

The length of the chord line of the three arches is the same, viz., 156 ft. 6 in. intrados, and the rise or versed sine is 16 ft. English measure, being full $\frac{1}{10}$ of the chord.

The arch is an arc of a circle, whose radius intrados is 198 ft. $5\frac{5}{8}$, and forms between the radii passing through the extremities of the chord line an angle of 46° 26′. The depth of the voussoir, or tubular rib, including the flanches, is 2 ft. $10\frac{5}{8}$, and its breadth across the middle is equal to half its depth. Each tubular rib is composed of 23 pieces, having 11 lengths of about 14 ft. 9 in. on one side of the laminated wooden arc, whereas there are on the other side only 10 whole lengths and 2 half lengths, these half lengths being placed against the piers, in order to cross the joints so as to obtain greater rigidity, which by this combination became very considerable.

The wooden arc, which is composed of good, well seasoned fir, having been erected, greatly facilitated the work, for once cut to its proper shape, so as to leave a small space between the sides of the wood and the metal, the half voussoirs had only to be applied thereto, bolted together and forced up into their proper place by means of struts and wedges, after which keys were fitted into grooves reserved for the purpose at the extremity of each portion of the rib; and when all were ready they were gently forced down to a bearing, so as not to displace or deform the arc, beginning at the two two piers, and terminating at the centre, where the last key tightened the whole; and so great was the power of these keys, that with a light hammer I could lift the whole arc from the struts, or lower it again with the greatest ease imaginable. These keys enabled us, therefore, to set the ribs with great precision, and almost simultaneously, which circumstance is of considerable importance in the construction of an iron bridge, on account of the inconvenient effect produced by expansion and contraction of the metal.

The hollow rib offers considerable advantage over the flat rib, on account of its rigidity, which is so great as to be capable of resisting all lateral strain with the aid of very little cross framing, or horizontal bracing.

There exists, in the construction of this bridge a peculiarity which has probably not been generally observed, although we were afraid, previous to the work being finished, that it would produce a very unpleasing effect. The evil was, however, unavoidable, as it arose from the circumstance that the Administration des Ponts et Chaussées required a certain height under the centre arch at high water, and the Prefect de la Seine would not on the other hand, consent to the elevation of the roadway on the quay above a certain height. It became, therefore, requisite to incline the chord line of the two side arches, and although there is in each a fall of 2 ft. 8 in. towards the quay, the effect is scarcely perceptible, unless when the water in the river rises nearly to the spring of the arch, which only takes place in the rainy season.

By the above plan the road over the bridge forms a curve instead of a level, and probably gave rise to the idea that the centre arch was of greater span than that of the other two. The curve of the road was still further increased, so as to obtain the level of the quay, by diminishing the diameter of the circular bearing rings against the buttress to 11 ft., whereas the diameter of those next the pier is 12 ft. $5\frac{5}{8}$.

Great attention was paid to the form of section of the tubular rib, in order to avoid any bad effect that might result from contraction in the casting, and such care was taken in moulding that very little remained to be done to the pieces when they came out of the sand. The tubular ribs were cast and faced at the Forges et Fonderies de Fourchambault, under the management of M. Emile Martin, who paid very particular attention both to the quality of metal employed, and to the moulding of the pieces.

The general allowance for contraction of cast iron in cooling is $\frac{1}{100}$, and this was found to be as near as possible the case. But the greatest difficulty to overcome was the tendency of these voussoirs to bend as they cooled, and that in consequence of the outer edges of the flanches cooling faster than the centre part, because it is well known that the slower the cooling process is carried on, the greater will be the contraction of the metal. To obviate this it was found reqnisite to curve the model itself about $\frac{3}{4}$ of an inch in the length of 14 ft. 9 in.

The circular rings and other cast iron pieces were cast partly in Paris, but the greatest portion in Normandy: with the exception of the facing of the voussoirs or tubular ribs, all the fitting-up was done on the spot.

The object of having these circular supports for the roadway was to obtain a certain degree of elasticity, sufficient to preserve the tubular ribs against the vibration of the road when carriages heavily laden are passing on the bridge; and this desideratum was most effectually attained, for I have frequently examined the effect, and have invariably found that when under the influence of a heavy load, and while the road was vibrating considerably, that, owing to the elasticity of these rings, the tubular ribs were perfectly steady. I shall be happy to add some further remarks on this subject, if you consider this paper to be worth inserting in your useful Journal.

I am, Sir,
Your obedient servant,
London, July 19, 1842. H. H. Edwards.

[We shall, with much pleasure, receive any other communication Mr. Edwards may forward us.—Editor.]

MR. CHARLES WYE WILLIAMS' BOILER PROJECTS.

Sir—I have just been perusing a table of "Experiments on Furnaces and Steam Boilers," submitted by Mr. Charles Wye Williams to the British Association, and it is with unfeigned regret I observe the valuable time of the Association is occupied with such matter. The ostensible object of this table is to show the superiority of Mr. Williams's mode of effecting combustion over the plan usually adopted, but never was a table made less calculated to accomplish this object, and more likely to destroy the last vestige of professional confidence reposed in its author. The use of coal to steam engine boilers is the generation of steam, and I should imagine that even Mr. Williams himself cannot deny that that mode of combustion is the best which practically is found to generate the greatest quantity of steam with the least expence; and Mr. Williams may, when he first has leisure, begin to convince himself that he will not be benefitted by telling steam-vessel proprietors (to whom economy of fuel is of the greatest importance) that he has found a means of increasing the heat of flues, if he cannot also tell them that the consequence of such increase of heat is (and should not be) an increased evaporation of water by a given quantity of fuel. Mr. Williams, in his ten deductions from his two tables, has under consideration the quantity of water evaporated per unit of coal, economy of time, as he calls it, and the perfection of combustion. In his first deduction he says, that "the quantity of water evaporated by any given weight of fuel furnishes no test of the quantity evaporated in any given time." In the second, that "the quantity of water evaporated by each pound of coal is a very inadequate test of the quantity of heat given out by such coal." In the third, that "as the weight of water evaporated per pound of coal bears no proportion to the weight of water evaporated per hour, economy of fuel may be the reverse of economy of time." In the fourth, that "the area of the furnace has no necessary connexion with the heat generating power of the coal." In the seventh, that "the temperature of the products escaping by the chimney will be in the ratio of the heat in the flues, and both in the ratio of the rate of combustion and the quantity of heat generated," and so on through his other deductions. Now, in the name of all the smoke-preventing schemers of the present day, what has any one or all of these deductions to do with the superiority of Williams' furnace over the common one, if Mr. Williams can tell, I shall be much obliged to him, for so far as I can see, they are of use only in mistifying the subject, and enveloping it still more thickly in dense clouds of smoke. The mode of testing the economy of fuel with any kind of furnace or combustion, is of the simplest description, and to all schemers there is only one course open:—let them find how much water can be evaporated per unit of coal, used in the common way, with any boiler, and let them find how much fuel used in their way is required to evaporate the same quantity of water in the same time, with the same boiler unaltered, except in the furnace. Such is the way in which they will meet the case in practice, and such is the way in which they must treat it to procure the confidence of steam-vessel proprietors, and I may perhaps be allowed to add such is the way in which Mr. Williams' table does not treat it.

I am, Sir, your obedient servant,
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* Drawings of this bridge are given in the *Journal*, Vol. II. p. 79.

WOOD PAVING.

1. *On the Use of Mechanical Power in Draught on Turnpike Roads, with Reference to the new System of Wood Paving.* London: Blackwood, 1842.
2. *Wood Paving in London; a practical Treatise.* By J. LEE STEVENS. London: Spencer, 1841.
3. *Wood Paving in the Provinces.* By the same.
4. *Prospectus of the Marylebone Practical and Scientific Association for the Promotion of improved Street Paving.*

OUR earliest associations heretofore have taught us, in thinking of great roads as works of art, to esteem durability as their chief excellence, and a compact mass of stone as the best means of ensuring this attribute. Talk of engineering monuments, and the Appian Way rises before the mind's eye, or some of those many roads of the Romans which, after centuries of wear and tear, still bear on them the ever-flowing tide of traffic. And now this is to be as a dream; our ancient prepossessions in favour of stone or a macadamized concrete are to give way to what has been considered a most perishable material, one rejected in all structures in which the property of durability is to be consulted. We are not totally unacquainted with wooden roads, for the corduroy roads of America have made us familiar with them; but whatever our ideas may be of their capability of holding out against the ravages of time, we have too little liking for them, too little opinion of their comfort, to give them any chance of jolting our successors, when we are able to afford a more costly road. It is, nevertheless, true that the experience of two or three years has been sufficient to establish the efficiency of wood as a paving material, and to ensure it a large future extension.

Our prepossessions on the subject have been that wood as a paving material would be subject to great abrasion, would rapidly decay under the influence of weather, and would present a very slippery surface. The effect of damp upon wood, however, is rather paradoxical: if partially subjected to damp then decay ensues, but while kept constantly damp the injury is trifling. The abrasion experience has proved to be less than that of granite, while the practical operation, as we shall hereafter show, is such as allays all fears on that ground. As to the slipping of horses, the greater frequency of its occurrence upon wood paving is very questionable, while it is an evil which attaches only to a partial line of wood and stone paving, for were wood used on a large scale, an alteration in the shoes of horses, such as has been well provided by several inventions, would wholly remove this cause of objection.

Having, therefore, in wood a paving material of sufficient durability, whether we regard resistance to weather, or to abrasion from the weight carried on it, we have now to look at it in operation. In all specimens which have stood well we find an upper layer of wood reposing on a bed of concrete; for as to the idea of dispensing with the underlayer of concrete, it is one the fallacy of which has been shown and abandoned. The concrete we regard, therefore, as an essential feature of the system; and thus we have a non-elastic stratum of concrete with an elastic covering of wood, or a jacket, as it may be termed, in reference to its operations in defending the concrete from the weather, and a buffer, as repelling the shocks of the carriages traversing the road. Now it is in these elastic properties that, according to us, the whole secret of the success of wood-paving lies. Let us consider that there is not merely the road, which has to be provided for, but also the power which traverses it. Theoretically it might seem that the smoother and consequently the harder and more durable the road the better; but there is, as we have said, the power using the road to be taken into account, and the difference between an elastic and a non-elastic road is great in this respect. For as in the case of resistance to impact on the part of the non-elastic medium, the whole is distributed through the elastic medium of the power, so to speak, traversing the road, so, in the case of an elastic medium, this resistance is divided, and thus apparently diminished. Familiarly, this is illustrated by the example of wood and stone stairs: while we run up stone stairs our feet are pained, and we get sooner tired, to which the softness of the wooden stairs is an immediate relief. Therefore, upon the elastic medium we can do more work, either as to quantity or as to the length of time in which we are employed on it. This is the case with the horse: when it gets on the wood pavement the relief is sensible; instead of the whole resistance from the impact with the stone being communicated to its feet, as in the case of stone, it is distributed. If we consider the structure of the horse's leg, the natural habits of the animal, and the serious effect of a London pavement in shortening its working life, we must feel very sure that, on the ground of comfort to the horse alone, the advantages of wood-paving are very great. Indeed, upon some lines of road, where there is much wood pavement, the sensible benefit to the omnibus and cab proprietors is acknowledged, and the extension of wood-paving must tend greatly to utilize the power of the horse, and so to reduce the price of his labour under every head, whether of length of life, of health, or of subsistence. Animate power is, nevertheless, not the sole power which we have to consider: a short space of time must bring the steam carriage also on the road, and we must provide for that. But the steam carriage is in a like manner provided with delicate and elastic machinery, and we know that the effects of vibrations on hard surfaces are greatly to increase the wear and tear and consequent expense of the machine. On this ground, therefore, the wood pavement is also to be preferred, in which respect many advocates of the steam carriage system have admitted the superiority of wood. So far, then, as to the mere effect of vibration on the elastic power employed, whether animate or inanimate; but in the case of animals, there is also a voluntary action which, although little regarded, is worthy of some attention. All those who attempt to estimate dynamically the results of muscular action, are well aware how much the will and disposition, the nervous condition of the animal, has to do with it, and under all circumstances, we should consider that wood would be more favourable to the exertion of the powers of the horse. What the seaman call "working with a will" is half the battle, and those who have noticed the wood pavement in Oxford-street must have seen the evident pleasure which the omnibus and cab horses have in running upon the easier surface.

In thus considering the tractive power we have perhaps travelled a little out of the logical order, for we should first have considered what is the quality of a wood surface with regard to the degree of resistance it affords to the traffic passing over it. We thought this, however, less important, for the capability of having tight joints is evident, and the smoothness of wood is one of the apparent objections to it. Presenting, therefore, an evident superiority over stone as to surface, the saving in wear and tear of carriages must be consequent. Attributing to wood that it causes much less wear and tear than stone to animals or vehicles passing over it, the converse of this is that those animals and vehicles must cause less wear and tear to the road, and, therefore, a very heavy item of expenditure be sensibly diminished, as also the amount of toll levied for the maintenance of the road. We may perhaps here mention that, according to Mr. Macneill's opinion, based on the relative wear of the iron of horses' shoes and of the tires of the wheels, that the wear and tear of horses' shoes and consequent destruction of the road is much greater than that of wheels, and the injury, consequently, of a steam carriage would be less than that of a coach and horses. While bringing in corollary opinions of this kind, we must not dismiss the question of elasticity without referring to the evidence of Mr. Macadam, as to the good effects of laying over a bog a Macadamized road on an underlayer of hurdles, which is the system of wood-paving reversed. It may, however, suggest some ideas.

As to the details of wood-paving, we are on the present occasion incurious about them, whether they ought to be cubes or hexagons, or what, provided always that they are laid upon a solid substratum. The mode in which the blocks are laid, as to the grain of the wood, is important to be considered, whether with the fibres vertically, horizontally, or diagonally. This is a subject well worthy of experiment, first in relation to the mechanical strength, then as to abrasion of surface, and further as to the beneficial effect or otherwise of the admission of damp by the fibres. Another subject for experiment is as to the durability of wood under several circumstances: first, under alternate wetness and dryness, and secondly, while in such condition, as to the effect of frequent traffic or otherwise. It appears at present that, while bearing considerable traffic, wood will stand exposure to all weathers; while in many other circumstances seemingly more favourable, it is attacked with rot. The cause of this has never been satisfactorily ascertained; but it remains as the subject of experiment, like the anomalies in iron rails, where, side by side, will be found rusty rails and bright ones, under nearly the same circumstances.

Looking at wood-paving in its various relations, we come to another topic—the convenience to the public from the sound of the wheels being deadened on the wood pavement. The greater quiet which ensues is much appreciated by the shopkeepers and other residents in large thoroughfares; but the convenience is not less to the passengers. Those on the footway and those in carriages, besides having freedom from noise, which is a great relief to many, are enabled to converse, which at present, in Cheapside or the Strand, is often impossible. It is on this ground of greater quiet that wood-paving has been already adopted around many churches and public buildings, and its extended use for this purpose will not only benefit the auditories but also the public, whose progress through the thoroughfares on Sundays is greatly impeded by the barriers placed for diverting the carriages from places of worship. Around the New Church in the Strand, at St. Giles's, the Old Bailey, and many other places, wood-paving has been successfully used, and we hope it will be even more extensively adopted. Cleanliness is another requisite of public accommodation, which is a recommendation of wood-paving.

On the ground of economy, the first cost of wood-paving, taken in conjunction with the outlay for repairs, successfully bears the comparison with granite or macadamized roads, while the economical advantage in the wear and tear of horses and vehicles is still greater.

Wood-paving has now been pretty extensively adopted in the metropolis, and a good part of the line from the Mansion House by Oxford-street to Regent-street, and by the Strand to Westminster Bridge, is laid with it, and these several portions we hope to see united, so that it may be tried upon a more satisfactory scale than has yet been done. Not that we have any distrust as to it, but because we think that scope has not yet been afforded for the full display of its good qualities. While on this subject we may mention, incidentally, that Mr. Bradwell, the machinist of Covent Garden Theatre, the inventor of the artificial ice laid down in Baker Street, in the New Road, and in the Colosseum, in 1835 submitted to the City Paving Commissioners, a system of wood-paving, similar to that afterwards laid down in the Haymarket, but the idea of wood was scouted by the Commissioners.

Now let us turn to the first work with the title of which we have headed this article. It is devoted to the advocacy of the steam carriage system, as the best means of effecting which it maintains that it is requisite to pave the turnpike roads with wood. According to the author, and to Mr. Worsley, one of the steam carriage inventors, in a pamphlet published by him, "the only real difficulty at present to the general use of the steam carriage instead of horse power arises from the great inequalities of surface resistance on the common roads." These inequalities of surface resistance are said in some cases to require an 8-horse, in others perhaps a 40-horse power, "arising from the softness rather than the roughness of ordinary roads, which are formed of materials varying in nature and quality, liable to be affected by every change of atmosphere." The remedy for this is said to be found in wood-paving, as it presents the same firm and even surface in all seasons and weathers. It is recommended, therefore, to wood-pave all the turnpike roads, when the superior economy and speed of the steam carriage over horse power will, it is expected, be brought to bear.

Mr. Stevens is the agent and professed advocate of the Metropolitan Wood Pavement Company, the most successful company hitherto, and of course his strain is all leather. The author of the first pamphlet has also a preference for this company, but his reasoning is general.

The contest in the Marylebone Vestry on the question of paving Oxford-street with wood was conducted with great acrimony, and with a spirit of partizanship such as to disgust all well-thinking men. When, therefore, this matter was decided by the triumph of the wood-paving party, sober consideration as to the importance of paving as an item of municipal expenditure, and the expediency of economizing under this head, led to the novel circumstance of a local society being founded for the promotion of improved street-paving, which has been organized, and we hope will be successful in its exertions. Unpledged to any particular system, whether of wood, of stone, or of granite, the object of the supporters of this institution is to point out to their fellow-parishioners the best mode by which paving can be effected, and the funds of the parish economized. It is, in fact, a local association for carrying out similar objects to those of the Metropolitan Improvement Society, but in a more restricted way. When we consider the large amount of local taxation in this country, direct and indirect, scarcely under ten millions, in the shape of poor rates, county, church, highway, paving, sewer, and lighting rates, and turnpike tolls, the class of persons by whom these sums are expended, and their woful ignorance of their duties, with its attendant prejudices—the Poor Law for example—we may feel fully assured that a very large amount of money is wasted which has been already raised in ways oppressive to the community. The necessity, consequently, of public enlightenment on municipal administration is very great, and no better means exist for the attainment of this object than the formation of local societies like the Marylebone Street Paving Association. A less expenditure is not always the cheapest mode of administration, while mechanical circumstances will often impede the best-intentioned but uninstructed administration. One parish in London lost several hundreds a year by using dirty scales in the workhouse; others have suffered by receiving hot bread instead of cold, bread losing often as much as five per cent. in cooling, a difference pocketed by the contractor. It is by intimate acquaintance with details, therefore, and not by party wrangling, that the public funds are to be saved, and it is highly desirable that the well-instructed and independent members of the community should bear this in view. To Mr. Charles Cochrane, the founder of this Association, we think great praise is due. Being a member of the Marylebone Vestry at the time of the above-mentioned Oxford-street discussion, he employed himself zealously in collecting all the evidence he could as to the durability of wood in various positions, the results of which investigations he detailed in his speeches to the vestry. In deciding the opinion of the vestry in favour of wood-paving his exertions had great weight, and subsequently as a permanent means of benefiting the parish he established the Association in question. Independent in his social position, of large fortune, unbiassed in favour of any particular plan, the motives of Mr. Cochrane cannot be impugned, and he may rest assured that by the example he has afforded, which will have its weight in other places, as well as by the good he has effected, he has conferred a greater benefit than if he had availed himself of his standing for those party and political purposes which are so much more tempting. Had he obtained a triumph for blue or yellow, had he turned out the functionary of one party to put in the nominee of another, he might have ensured greater applause from his constituents, but he would not have done so much good. We cannot impress too much on all parties the propriety of giving up party warfare where local interests are involved, requiring the most prudent and careful consideration.

In conclusion we strongly recommend all public bodies who are about to adopt wood-paving, to take the precaution of having a good bed of concrete, of Thames sand and stone lime, with a small portion of Roman cement and puzzolana. As to wood without concrete, it is quackery, and a waste of money.

SCULPTURE IN ARCHITECTURAL DESIGN.

(From the Athenæum.)

If in one of its shapes, the spirit of calculation has been prejudicial to architecture in this country, it has, in another, occasionally been rather favourable to it, and given it an impulse. While it has prevented many of our public structures from being what they ought to have been, causing them to be turned out of hand maimed, hurried off, unfinished productions; it has sometimes, in the case of private speculations, led to a degree of architectural display that contrasts forcibly with the grudging penuriousness which has hitherto been allowed to *manifest* itself so offensively in works of greater importance—those from which our taste as a people is likely to be judged by other countries. On examining the numerous public structures erected within the last five-and-twenty or thirty years, we find quite as much cause for regret as for congratulation—for regret that so little should have been made of the respective opportunities afforded; and that, too, not so much in consequence of economy, as from want of judgment and taste; and owing to the designs not being properly matured—to their not being purged from inconsistencies—and to there being a more or less offensive disproportion between the character aimed at and the mode in which it has been carried out. Nor can we refrain from here remarking, that while architects lay so much stress on the proportions of the orders, &c., which are only matters of mechanical routine, easy enough to be learned even by the dullest, few of them pay attention to what may be called *artistical proportion*—to that of the *ensemble*, so that this last shall be in perfect "keeping," and homogeneous in character, instead of looking, as is too frequently the case, no better than a compilation of ill-assorted fragments, where pretension and meanness go hand in hand. The list of *lost opportunities* would be one of some extent; and we should certainly place in it more than one structure or architectural improvement, which less fastidious and less *exigeant* or more good-natured critics have not scrupled to commend. Buckingham Palace, the Post Office, British Museum, Mint, College of Physicians, York Column, Covent Garden Market, King's College, the Cemetery at Earl's Court, and numbers numberless would be so classed by us, notwithstanding that it is not difficult to point out in every one of them some individual merit—some solitary feature, perhaps quite an accidental one—for which it may be praised, if we choose to shut our eyes to the solecisms and sins by which it is overwhelmed—to the frigid dulness and insipidity, or vulgar taste and architectural bathos manifested in each of them as a whole. It avails not to say, that in many instances the architect has not fair play, that sufficient means are not afforded to enable him to do all he could wish; because it behoves him to display his ability by making the most of the means which are afforded him, instead of injudiciously aiming at more than, as he must or ought to be aware he can at all satisfactorily accomplish. If architects are so pinched by their employers that they cannot finish up their buildings consistently, why, in the name of common sense, do they squander away so great a part of their pecuniary resources upon such extraneous common places as columns and pilasters, dragged in for the nonce, as if for the express purpose of making the poverty of the rest of the building all the more apparent and offensive; and in such manner as to bring columns and porticos now almost into disrepute? Such a system is no less at variance with economy than with good taste; and has served only to fill the land with buildings in a pseudo-Grecian style, marked by an offensive mixture of showiness and poverty—with what is, in fact, hardly worthy of the name of style at all, it amounting to no more than feeble, mechanical mannerism. Private speculation has, on the other hand, occasionally encouraged architectural design on a scale of liberality that contrasts forcibly with the petty parsimony observable in buildings of a higher grade, and where it becomes positively offensive. The shop architecture of the metropolis has improved, although by no means in the degree that could be wished; since, for the greater part, it exhibits more of expensive showiness than of either good taste or invention. The individual architectural specimens of this class, which deserve to be pointed out, are comparatively few; for when we have mentioned one at the corner of the Quadrant, opposite the County Fire Office, at the corner of Oxford Street and Berners Street, another by Mr. Inwood, in Old Bond Street, a fourth in Tavistock Place, by Mr. Maddox, and one just opened in Aldgate—which last is a more striking façade of its kind than, perhaps, any other in town—we have enumerated nearly all that are remarkable for more than the superficies of plate glass. There is, however, one piece of architecture which, though it does not exactly answer to the name of *shop*, belongs to the same caste, and which certainly may be referred to with approbation; we mean that called the Kemble Tavern, at the corner of Bow Street and Long Acre. Notwithstanding that it is executed merely in compo, and that it is now barbarously disfigured and vulgarized by certain very unclassical insignia of the business to which it is devoted; in point of design this building puts to shame many which are constructed of far more durable material—some of them, too, by men of eminence in their profession—persons who would, doubtless, stand amazed, if asked to make a design for a similar purpose. When we look at the two new Assurance Offices in Bartholomew Lane, at the "Atlas" in Cheapside, or the "Westminster and British" in the Strand, we feel not only dissatisfied, but convinced, that the architect of the Kemble Tavern would have acquitted himself far better, and made much more of them, had the opportunities been afforded him: in saying which we are at any rate unprejudiced, for of the individual we know nothing whatever, but form our opinion solely from that sample of ability and taste. He certainly has shown more than ordinary *gusto* in that little production, which, though not quite so celebrated, is, we venture to affirm, a better piece of design than Palladio's House at Vicenza. He—that is, the Bow Street, not the wonderful Vicentine architect—has there introduced some novel and pleasing ideas, and in adopting the Tivoli example of the Corinthian, he has not, as some others have done, omitted what is so strikingly characteristic in the original, namely, the "bossy sculpture" of the frieze, deprived of which the whole is thrown out of keeping, and the entablature no longer agrees with the columns. At the same time we must admit that he has, in one respect, deviated both from the character of the order, and from that of the rest of his own design, inasmuch as he has made the antre-caps by far too plain, so that they contrast disagreeably both with the entablature and the capital of the columns themselves; which is, in our eyes, a greater blemish than the accidental disfigurement we have alluded to.

Among other architectural speculations belonging to the *genus* "shop," we have the Pantheon Bazaar and the Lower Arcade, either of which might almost satisfy the most *Pennantizing* antiquary for the loss of old Exeter Change. As a speculation, it may be doubted whether the "Arcade" has answered; neither does it seem to have conferred any reputation upon the artist who designed it; yet it is, nevertheless, a tasteful and scenic *merceria*, and is, besides, admirably accommodated to a climate like ours.*

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* We have just heard that a similar *passage*, as the French call it, is about to be formed, extending from Wellington Street North, facing the English Opera House, to Catherine Street. The situation does not promise much for the scheme, because no additional communication or thoroughfare in that direction seems to be required; whereas it would be a great public improvement could some of the narrow lanes and alleys, in different parts of the town, be converted into well-paved covered passages, so as to be cool in summer, and clean and dry in wet weather.

APPARATUS FOR REVERSING ENGINES.

Sir—Having seen in your valuable Journal a description of a method for reversing engines, by the use of the common side valve, making the induction and eduction pipes alternately steam pipes, I submit to your notice a method of accomplishing the same in a much more simple manner, as will be seen on reference to the accompanying diagram, and shall feel obliged by your giving it a place in your forthcoming number.

Fig. 1.

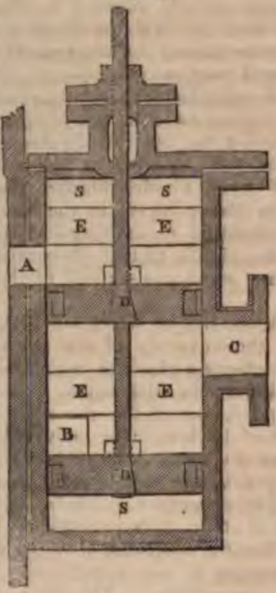


Figure 1 represents the section of a cylinder and nozzle of the form generally used, with the addition of a valve for reversing, made with two pistons to obviate the pressure attendant on the use of the slide valve—the pressure on the pistons being the same on both ends.

Figure 2 is a horizontal section of the same.

Figure 3 is a section of the valve for reversing; C passage to condenser; S steam pipe; A and B passages leading to nozzle. The letters are the same in all the diagrams.

Fig. 2.

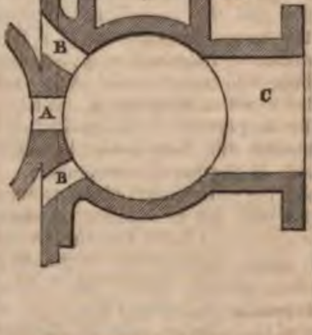
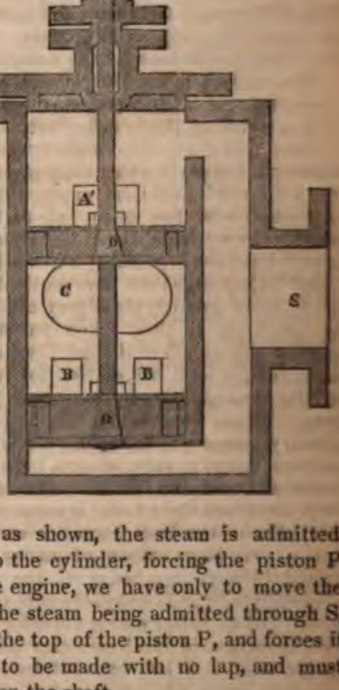


Fig. 3



In the position of the valve as shown, the steam is admitted through S, passing through A into the cylinder, forcing the piston P up. If it is wished to reverse the engine, we have only to move the piston valves to E E, as shown; the steam being admitted through S, as before, passes through B B to the top of the piston P, and forces it down. The slide valve will have to be made with no lap, and must be worked by an eccentric keyed on the shaft.

In large engines where expansion valves are used, they could be set so as to cut off the steam to the end of the stroke, as the slide valve would be open to the full length of the stroke. The piston valves would also act as a throttle valve, and could be worked easily by one man in a pair of large engines, whereas by using the slide itself four or six would be required. This would, I should think, add greatly to its efficacy by being so easily under control—more especially in the Thames and the Clyde, in the latter of which it is often necessary to stop and reverse every two or three minutes.

May 17, 1842. SEYTON.

P.S.—Lap is not applicable to a valve to be worked by an eccentric keyed on the shaft to work the engine both ways, for if it was set right for going a-head, it would be too late to reverse.

[We think very favourably of the plan for reversing engines communicated by our correspondent. In large engines its employment might supersede the necessity of throwing the engine out of gear, and the use of starting apparatus, and would confer a facility in starting and reversing which does not at present exist. We do not understand what our correspondent means by cutting off steam to the end of the stroke. The expression seems to us to involve a contradiction, inasmuch as the act of cutting off means the prevention of more steam entering the cylinder at some point of the piston's progress before the stroke is completed. We may further observe that although it is quite true that lap is inapplicable to a fixed eccentric intended to move the engines both ways, it is not inapplicable to a fixed eccentric in ordinary engines, for in ordinary engines no fixed eccentric *can* move the engines both ways. Lap is only inapplicable in the case of some double-ended levers, or in the mode of reversing our correspondent recommends.—EDITOR.]

THE VARIATION OF THE COMPASS.

Observations made at the Royal Observatory, Greenwich,
G. B. AIRY, Astronomer Royal.

Mean Magnetic	Variation.	Dip at 9 A.M.	Dip at 3 P.M.
	° ′ ″	° ′	° ′
1842. May	23 11 39	68 45	68 46

STEAM NAVIGATION.

THE "ATMOSPHERIC" STEAM-BOAT.

THIS vessel is adapted for river navigation, the hull is entirely of iron, but with deck and fittings of timber. She was built by Messrs. Ditchburn and Mair, the eminent iron boat builders of Blackwall.

The length between perpendiculars is 150 ft.; breadth of beam, 18 ft.; depth of hold, 9 ft. 9 in.; and draught of water, 4 ft. 8 in.

The engines were constructed by Messrs. John and Samuel Seaward and Capel—they are upon the old atmospheric principle. There are three cylinders placed immediately under the line of shafts, with the cranks set at an angle of 120 degrees, so that in every portion there is the full power of one cylinder in action, which produces an equable and uniform motion. There are no cylinder covers or piston rods, as the connecting rods communicate at once from the pistons to the cranks. The pistons are forced upwards by the pressure of the steam, and then allowed to descend again by the production of a vacuum underneath, the air constantly pressing upon the upper side. There is one condenser and one air-pump connected with the three cylinders.

The engines have been worked several times, and are represented to have performed most admirably and efficiently, and the boat proved to be of unrivalled speed.

The following are the proportions of the engines:—the cylinders 47 in. diameter, and 3 ft. stroke; the pistons make 34 strokes per minute; the pressure of the steam is represented to be 8 lb. on the square inch; the paddle-wheels are 16 ft. diameter, and have 24 boards, 9 ft. long by 14 in. deep.

The power of the engine may be calculated thus:—if we take the pressure of steam in the upward stroke at 6 lb., and the pressure of the atmosphere occasioned by a vacuum underneath the piston, on the downward stroke at 13 lb., allowing a trifle under the full weight of the atmosphere, we shall have a mean pressure of $\frac{6+13}{2}=9.5$ lb. on the upward and downward stroke; and the velocity of the piston $(3 \text{ ft.} \times 34 \times 2)=204$ ft. per minute; and the area of each cylinder $(47^2 \times .785)=1735$ in.; we shall have for the power of the 3 cylinders $\left(3\ \frac{9.5 \times 1735 \times 240}{33{,}000}\right)=306$ horses nearly. And if we take the same proportion of nominal power to the effective power as in the ordinary low pressure marine engine, which is generally half, we shall have the nominal power of the three cylinders $=153$ horses, which it must be admitted is a tremendous power for so small a vessel. We cannot, therefore, be surprised that the boat is one of the fastest, if not the fastest on the river.

We are at a loss to conceive what advantage Messrs. Seaward and Capel expect to gain by the revival of the atmospheric engine for navigation purposes, except it be to get a longer stroke in applying the direct action principle. Against this we have double the capacity of steam cylinders, consequently nearly if not quite double the weight and expense, besides the very serious evil of exposing the interior of the cylinder at every downward stroke to the cooling influence of the atmosphere.

To show that the cylinders are double the capacity of those constructed on the ordinary principle, let us take the pressure of the steam as above at 6 lb., and the vacuum equal to 13 lb., which together is 19 lb., just double, at each upward and downward stroke; at the mean pressure taken in the above calculation, therefore, one half the capacity of cylinder will be sufficient. Again, let us prove this more clearly, by calculating the power of two cylinders working on the ordinary reciprocating principle, each $40\frac{11}{16}$ diameter; the area of the two being 2600 inches, rather less than half the collective area (5205 in.) of the atmospheric cylinders, the power will be, taking the same stroke and velocity as before, and pressure $(6+13)=19$ lb,

$$\left(\frac{19 \times 2600 \times 24}{33{,}000}\right)=305 \text{ horses.}$$

The Steam Association.—We must honestly confess that the Steam Association has disappointed our hopes, in common with most persons interested in the advancement of the art of steam navigation. Not that we have any fault to find with anything the Association has done—all of which is useful in its kind, and in our eyes has been wisely planned and ably prosecuted—but that many things have been left unattempted of far greater moment than any of those to which attention has been given, and which the Association and it alone is competent to undertake. What, for example, can be of greater importance than the establishment of a system of registration, such as that in use in Cornwall, of the consumption of fuel in different steam vessels, in relation to the power exerted? and who but the Steam Association could establish such a system? The duty of the Cornish engines has by this simple expedient been raised in the course of a few years from 26 millions of pounds raised one foot high, by a bushel or 84 lb. of coal to 120 millions—an increase of mechanical virtue of nearly 5 times, simply in consequence of the care and emulation the system of registration has excited. It would be too much perhaps to expect an equal increase of efficacy, or equal diminution of expense in steam vessels, but that great improvement would be effected by registration is scarcely to be doubted; and as it is the propelling power which constitutes the great expense in the maintenance of steam vessels, we think the attention of the Steam Association should first be given to that subject, and that the discussion of pilotage laws, harbour duties, &c.—which, however settled, can effect steam interests little in comparison with the economization of fuel—might be wisely postponed until a system of registration has first been organized. We refrain from going into any details relative to this question for the present, and must be content with saying that in our apprehension the details do not involve any practical difficulty or inconvenience. We trust the Association will speedily give its attention to this subject, and will use its best efforts to assist or facilitate the accumulation of all statistics of steam machinery that appear calculated to advance steam navigation, and promote the interests of those engaged in it. Hitherto the Association has been the representative, not of all the considerations proper to steam enterprise, but of those only which have a commercial complexion, and which any association can do the least to ameliorate. It does not augur well to see our engineers and ship-builders present only at the annual dinners; but we trust to see them soon taking a part in the Association's proceedings, and to see the Association assume its proper position—not of the representative of the counting-house—but of the representative of the science.

The Locomotive, No. I.—A boat with this cognomen is now running between the Adelphi Pier and Greenwich. She is fitted by Messrs. Braithwaite, Milner and Co. with a locomotive engine precisely the same as those working on railways, with the exception that it is taken off its wheels, and set upon bearers laid across the bottom of the boat, and instead of the railway wheels there are fixed upon *each* end of the driving or cranked axle a pinion wheel, 2 ft. 4 in. diameter, which works into a cog wheel 7 ft. diameter, keyed on to the shaft of the paddle-wheels; the shaft is in one piece, and has a bearing in the centre upon the top of the boiler. The engine is what is generally termed a 10-ton engine, fitted with two cylinders, 12 in. diameter, and 18 in. stroke; the pistons make 100 to 130 strokes per minute. The boiler is 3 ft. 2 in. diameter, and contains 84 tubes 2 in. diameter and 8 ft. 6 in. long, and a circular fire box, 3 ft. 3 in. diameter. The pressure of the steam within the boiler is from 45 lb. to 50 lb. on the square inch. The paddle wheels are 11 ft. 4 in. diameter, with float board 10 in. deep, and 5 ft. long. They have a dip of about 18 in., and when the engine makes 100 strokes per minute the paddle-wheels make 33 revolutions. The length of the boat, which is iron, is 103 ft. on the water-line, with a beam of 11 ft. 6 in., and draws 2 ft. 2 in. when light. The total weight of engine, boiler, paddle-wheels, and coal boxes, is 12 tons; the engine room occupies 21 ft. in length of the boat.

The speed is equal to about 12 miles through the water; and the consumption of fuel is about the same as on railways. In consequence of the engine being fixed in the boat instead of moving at such high velocities it does on the rails, there is nothing like the same wear, or so much liability to derangement. There are one or two evils attendant upon the present use of the locomotive engine; one is, that in consequence of the muddy state of the water of the river Thames, the boiler is apt to *prime*, which may be obviated by making a larger steam chest than ordinary; there is also an unpleasant horizontal vibratory motion in the boat, in consequence of the horizontal and rapid movement of the pistons, which we think can be got rid of by placing the cylinders diagonally on the sides of the boiler. This alteration would also allow the moving parts to be got at much better than they now are, which, in consequence of being placed under the boiler, are very awkward to be got at. No doubt these defects will be easily got rid of, and other improvements introduced, under the able hands of Messrs. Braithwaite, Milner, and Co.

MISCELLANEA.

In last month's *Journal* we gave an account of the removal and shipment of the immense block of Granton stone presented by his Grace the Duke of Buccleuch for the statue of the immortal Nelson, and which is intended to grace the summit of the column now erecting in Trafalgar-square by Messrs. Grissell and Peto; we have now to record its arrival into the river Thames, and removal to Trafalgar-square. On Saturday, June 25, it was safely landed at Mr. Foote's wharf, Abingdon-street, Westminster, in the presence of a large number of spectators, and was conveyed by the aid of 22 horses through Parliament-street and Whitehall to its last and final resting-place, Trafalgar-square. The crane by which this ponderous mass was landed was erected about three years since, by Mr. Luke Embleton, of Southwark, under the superintendence of Mr. Thomas Searle, of Wapping Wall, and is a beautiful piece of mechanism. The work, however, of its elevation to the top of the column still remains to be effected, and we hope its accomplishment will be as successful as its journey hitherto. The stone in question is stated to weigh 30 tons, and has already been reduced to favour its more easy removal from a block weighing at least 45 tons; it is of the description known as "Craigleith," of the liver rock, and in point of durability equal to granite. We understand that the removal of this stone from the neighbourhood of Edinburgh to Charing-cross has been effected without either the breaking of a chain, or the splintering of a handspike. Mr. Bailie, the sculptor, has now his part to perform.

Claudet's Daguerréotypes.—We were much delighted to witness at the Adelaide Gallery M. Claudet's instantaneous process of taking portraits. To him is due an improvement which, we may say, is almost equal to the original discovery. Previously to this improvement, there was considerable difficulty in obtaining a faithful likeness, in consequence of the time required for a sitting, and also the necessity for having a clear sunny day for the operation; but now, in a strong light, it will require but a moment or two, and even on a cloudy day, as it was when we last witnessed it, portraits can be taken in from 10 to 14 seconds. To show the instantaneousness of the process, M. Claudet is enabled to take portraits of animals, trees, plants, &c. He has also introduced another important improvement—that of introducing a back ground, representing a landscape or interior. During the last month M. Claudet was honoured with a visit from the Queen Dowager, who had her portrait taken as well as of those of the suite who attended her. With these she was highly delighted, and expressed her astonishment at the rapidity of the process. We wish we could see this valuable processs more extensively employed in obtaining copies of some of our finest specimens of sculpture, paintings, and public buildings. Although M. Claudet at first devoted his attention with much praiseworthy effect in obtaining portraits, if we may use the term, of all the principal buildings in London, Paris, and Italy, he met with little or no encouragement. He was, therefore, obliged to devote his attention to a more profitable department—that of human portraiture, and, if we judge rightly from the number of persons who daily flock to his studio at the Adelaide Gallery, he will find it amply enrich his coffers, and make up for his previous losses. We with much pleasure recommend a visit to his establishment where may be seen portraits of many public characters, and of many celebrated buildings.

Asphalte Roofing.—It was remarked as a singular circumstance, during the conflagration at Hamburg, that roofs covered with asphalte, of which there are some here, opposed rather than encouraged the progress of the flames. It was imagined, on account of the substance of which these roofs were composed, that they would easily catch fire, and be the cause of great mischief; such, however, was not the case, for it appears that the fire had little or no effect on them: and when the roofs of the houses fell in, the asphalte, in which a sort of rubble is mixed up, was found to have resisted the effects of the heat, and like a mass of dirt, served rather to smother the flames than to give them increased vitality.—*Times.*

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 6TH TO 28TH JULY, 1842.

Six Months allowed for Enrolment, unless otherwise expressed.

John Harrison Scott, of Somers Town, engineer, for "*improvements in metal pipes, and in the manufacture thereof.*"—Sealed July 6.

George Edmund Donisthorpe, of Bradford, Yorkshire, top manufacturer, for "*improvements in combing and drawing wool, and certain descriptions of hair.*"—July 6.

Joseph Hall, of Cambridge, agricultural implement maker, for "*improvements in machinery for tilling land.*"—July 6.

Lady Ann Vavasour, of Melbourne Hall, Yorkshire, for "*improvements in machinery for tilling land.*"—July 7.

Richard Hodgson, of Montague-place, in the county of Middlesex, gent., for "*improvements in obtaining images on metallic and other surfaces.*"—July 7.

James Timmins Chance, of Birmingham, glass manufacturer, for "*improvements in the manufacture of glass.*"—July 7.

Charles Augustus Preller, of Eastcheap, merchant, for "*improvements in machinery for preparing, combing, and drawing wool and goat's hair.*" A communication.—July 7.

William Fairbairn, of Manchester, engineer, for "*improvements in the construction of metal ships, boats, and other vessels, and in the preparation of metal plates to be used therein.*"—July 7.

John Perring, of Cecil House, Strand, hat manufacturer, for "*improvements in wood paving.*"—July 7.

John Bird, of Manchester, machinist, for "*improvements in machinery or apparatus for raising or forcing water and other fluids, which said improvements are also applicable as an engine, to be worked by steam, for propelling vessels and other purposes.*"—July 7.

William Pritchard, the elder, of Burley Mills, Leeds, manufacturer for "*an improved method of consuming or preventing smoke, and economising fuel in steam-engine and other furnaces.*"—July 7.

William Revell Vigers, of Russell-square, Esq., for "*a mode of keeping the air in confined places in a pure or respirable state, to enable persons to remain or work under water and other places, without a constant supply of fresh atmospheric air.*" A communication.—July 7.

Jean Baptiste Francois Jouannin, of Upper Ebury-street, Pimlico, mechanic, for "*improvements in apparatus for regulating the speed of steam, air, or water engines.*" A communication.—July 9.

John Peter Booth, of the city of Cork, merchant, for "*improvements in machinery and apparatus for working in mines, which are applicable to raising, lowering, and transporting of heavy bodies; and also affording assistance in promoting a more perfect ventilation of the mine.*"—July 9.

James Crutchett, of William-street, Regent's park, engineer, for "*improvements in manufacturing gas, and in apparatus for consuming gas.*"—July 12.

Thomas Deakin, of Sheffield, merchant, for "*improvements in the manufacture of parts of harness and saddlery furniture.*"—July 12.

Jean Leandre Clement, of St. Martin's-lane, engineer, for "*improvements in apparatus for ascertaining the temperature of fluids, and also the pressure of steam.*"—July 12.

William Henry Stuckey, of St. Petersburgh, now of Upper North-place, Esq., for "*a pneumatic engine for producing motive power.*"—July 12.

Joseph Schlesinger, of Birmingham, manufacturer, for "*improvements in ink-stands, and in instruments for filing or holding papers and other articles.*"—July 16.

Robert Benton, of Birmingham, land agent, for "*improvements in propelling, retarding, and stopping carriages on railroads.*"—July 16.

Joseph Barling, of High-street, Maidstone, watch-maker, for "*improvements for producing rotary motion in machinery, worked by manual labour.*" July 16.

John Chatwin, of Birmingham, button manufacturer, for "*improvements in the manufacture of covered buttons.*"—July 16.

Charles Robert Ayers, of John-street, Berkley-square, architect, for "*improvements in ornamenting and colouring glass, earthenware, porcelain, and metals.*"—July 23.

Joseph Partridge, of Bowbridge, near Stroud, Gloucester, dyer, for "*improvements in cleansing wools.*"—July 23.

Eugene de Varroc, of Bryanstone-street, Portman-square, gent., for "*apparatus to be applied to chimneys to prevent their taking fire, and for rendering sweeping of chimneys unnecessary.*"—July 23.

Alexander Johnston, of Hill House, Edinburgh, Esq., for "*improvements in carriages, which may also be applied to ships, boats, and other purposes where locomotion is required.*" July 23.

Edward Cobbold, of Melford, in the county of Suffolk, Master of Arts, clerk, for "*improvements in the means of supporting, sustaining, and propelling human and other bodies on and in the water.*"—July 28.

TO CORRESPONDENTS.

"C. B."—*We cannot give any particulars at present of the progress of the large iron steam vessel at Bristol; we will try to do so the first opportunity.*

We very much regret to be compelled to decline inserting Mr. Tottie's comments on our criticisms in last month's Journal, for if we do so, we should then have similar comments from all other parties who may not like our notices of their productions.

Mr. Shuttleworth's Pamphlet on Hydraulic Propulsion on Railways must stand over for further consideration.

Books received and not noticed in the present Journal:—"Hand-Book of Manchester;" "On the Evaporative Power of Boilers, by C. W. Williams, Esq."

Errata.—In the Review of Mr. Booth's pamphlet, p. 257, in the fourth paragraph, lines 6 and 10, for *two* feet, read *four* feet.

EXPERIMENTS ON THE TENACITY OF WROUGHT IRON,

By James Nasmyth, C.E.

It may perhaps be interesting to some of the readers of your *Journal* to have an account of the results of some experiments which I have lately been making, with a view to obtain more correct knowledge of the nature of the important changes which take place in the *tenacity* of wrought iron, when subjected to various kinds of treatment, more particularly as regards the employment of wrought iron in the case of railway axles, &c. At all times, any addition to our knowledge of the nature of those causes which induce changes in the tenacity of wrought iron, ought to be considered as a subject of much importance, seeing that in so many cases our lives depend on the tenacity or strength of a piece of that material. This subject has, however, of late become infinitely more important, on account of the truly wonderful success and extension of the railway system, and as the whole of that vast improvement, in consequence, rests its success on the strength and tenacity of wrought iron, any addition to our knowledge on that subject cannot, I trust, but be considered of value.

The subject has, however, received much additional interest, on account of many *theories* and much controversy, which has arisen in consequence of an opinion which has been given forth from rather a prominent quarter, viz. the French commission appointed to investigate the *causes* which led to the late disastrous accident on the Versailles railroad. The most remarkable part of the conclusions which that body gave forth, was in substance this:—namely, that however tough and strong a railway axle might originally be as it came from the hands of the maker of the said axle, that the very fact of its being caused to revolve day after day in connexion with the rails, would ere long, through the agency of some mysterious electrical ! or magnetical influence, have its nature, as regards the toughness or tenacity of the iron, so impaired, as to become at length totally unsafe and unfit for use.

A more truly alarming and uncomfortable doctrine could not have been produced than this, inasmuch as we should never be able to know when the point of unfitness was attained, except through the occurrence of one of those disastrous and melancholy accidents which have but too certainly attended the breaking of a railway axle; and as the above opinion was based on conjecture as to the supposed influence of the most dark, hidden, and mysterious of all nature's agents, we might therefore have groped about in vain for such a knowledge of the subject as would be most likely to prevent such dangerous changes taking place in the tenacity of the iron; and moreover, by having our attention diverted to so *non*-understandable a class of natural causes, we should be likely to cease to search for the cause, cure, and prevention (which I trust my experiments will go to prove, have more intimate connexion with our workshops and workmen, than with philosophers and their laboratories); and as the results of the experiments I have made on this subject are applicable to the treatment of wrought iron generally in reference to its every day use, I trust that the results may be found of practical value, the more so as they go to prove that we have the cure and prevention entirely at our command, without calling for the slighest additional labour or expense in the treatment of wrought iron.

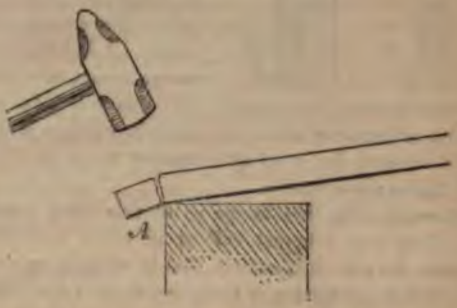
From former *practical* experience in the working of iron in the process of forging, I had always observed that, however tough, tenacious, and excellent in quality a piece of wrought iron might originally be, that, by certain treatment, that tenacity might be all but entirely destroyed; and as such treatment is very frequently absolutely necessary in the forging of wrought iron into certain forms, the knowledge of how to remove the bad effects consequent on such, became important to know. I am happy to state that this knowledge is so simple and easily put in practice, that I trust, in future, no piece of forged wrought iron will henceforth be applied to its purpose without having been passed through so simple and salutary a process, which you will find requires neither skill, labour, or cost worth naming. Having made these observations, I shall now proceed to work.

It either is or ought to be known to all practical men concerned in the working of wrought iron, that if a piece of the very best and toughest iron is hammered in the process of forging until it ceases to be red hot, that the effect of such *cold* hammering, as I may term it, is to cause the iron to become so brittle, that it will in many cases break across in the process; or if it does not at that time, this process of cold hammering has so removed and destroyed its tenacity, as to render it capable of being broken with the slightest blow; in order to prove this by direct experiment, I took a bar of the very best wrought iron, 1¾ inch square, and subjected it to the following experimental tests:—

Experiment 1.

A bar of the very best 1¾ inch square wrought iron, at temperature 60°, was laid over the edge of the anvil, [illegible] Fig. [illegible] the end projecting about 2½ or 3 inches over at A; with 9 heavy blows of a large sledge hammer it broke off short, as indicated in the figure, the fracture exhibiting that clear crystalline texture due to a good quality of iron *at that temperature.*

~~Fig. 1.~~



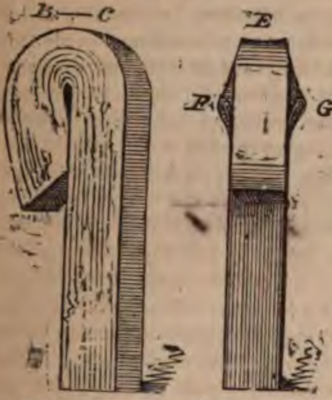
Experiment 2.

Part of the same bar of iron was taken and heated red hot, and hammered till it was nearly quite cold; when it had arrived at temperature 60° (same as the first experiment), it was placed on the anvil with the end overhanging as before, at A, *one* slight blow broke it sharp and square across, the fracture exhibiting a most beautiful *close* crystalline grain, more like the fracture of steel than iron, but such a fine grain as would (and indeed very frequently is) considered a proof of good quality, that is, fitness to be trusted to! So much for the appearance of the texture as a criterion of fitness. Here, then, we have distinct proof, by this experiment, that we have reduced the blow or shock-resisting quality of the iron fully $\frac{9}{10}$ by the effect of *cold* hammering alone; and what renders the knowledge of the effects of such a process the more important is, that in most cases we shall find that, in order to give the piece of forged work the requisite finish and fine surface, as they come from the hands of our workmen in that department, that this very cold hammering and *swaging*, as it is termed, is required, the more so as it is by such a process that iron forgings are so finished *from the hammer*, so as to require the least possible labour after, and as every good workman in that department is anxious to turn his work out of hand with the very best surface on it, which this cold hammering enables him to do, it is not a very easy matter, and (as I will soon show) *not at all desirable*, to require them to discontinue the practice, which many have endeavoured to do from want of a full knowledge of the subject. *There is nothing inherently wrong in this practice of cold hammering*—far otherwise; the evil rests with the applying such a cold hammered piece of forge work to its purpose without having been passed through the *curative process*, which is simply this, namely, to heat the piece of forged work in question to a *dull red heat*, and lay it down to cool at its leisure. The value of this most simple process will be well illustrated by Experiment 3.

Experiment 3.

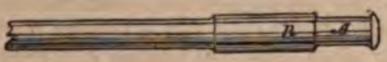
A piece of the same bar ~~iron as em~~ployed in the preceding experiments was, after being heated red hot and hammered till cold (which cold hammering produced, as is usual, a most beautifully smooth surface, in which good workmen delight), again heated to a dull red heat, and laid down to cool at its leisure; being then at temperature 60°, it was placed over the edge of the anvil as before, and after receiving 105 of the most vigorous blows of the same sledge hammer as was employed in the preceding experiments, it exhibited the most extraordinary evidence of tenacity, by resisting all attempts to break it, having passed into the form as given ~~of~~ Fig. that is, bent quite double, and the excessive distention across the part B—C causing the width across at E to decrease at least ⅜ of an inch, while the compression at the centre of bending caused the metal to expand a like quantity at F G. Every practical man knows that this is a most severe test of the tenacity of iron, and which the piece in question stood with the most perfect success, for even after having received 105 blows, no evidence of fracture was visible.

~~Fig. 2.~~



This third experiment then brings us to this most important conclusion, that there is no inherent evil or ill effect produced by cold hammering, *but far otherwise*, namely, that by subjecting wrought iron to the most violent hammering or compression at a low temperature, and then submitting the iron work so treated to the simple process of heating red hot and slow cooling, that we have enhanced its tenacity or shock-sustaining qualities at least twenty times. Here, then, we get hold of some *facts* which I trust I may consider to bear with some important effects on the treatment and use of iron, especially in the case of its application to railway axles, as from their very required form, the process of cold hammering and swaging is all but absolutely necessary in forging the bar of iron out of which they are formed into the requisite shape.

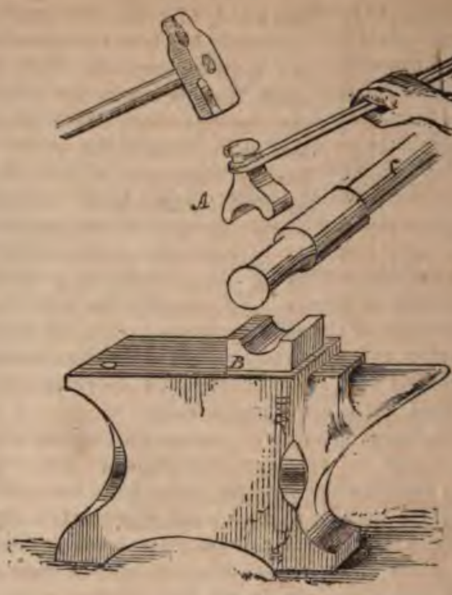
~~Fig. 3.~~



The above Fig. is the form of a railway axle (one half the length only is shown) as they are generally made, the bearings being at A, the wheels being keyed on the part B. In forging such an axle, the bearings are formed with the requisite collars at the ends by hammering the iron at that part by a series of direct blows of the hammer, and giving them the requisite finish or precision of form, so far as can be done previous to being finished on the turning lathe, by means of tools called swages, which consist of two pieces of iron covered with steel, and made smooth; and being of very nearly the same curve as the bearing of the axle, they enable the smith to transmit his blows with much greater precision, and also avoid all hammer marks.

Fig. may perhaps serve to convey some idea of what is termed a swage. A and B are the upper and under swages, which enable the smith to transmit the blows from the sledge hammer with the greatest precision, and to convert the blow of the hammer into a *compressing* effect over a very considerable surface of the cylindrical bearing of the axle. During the process the axle C would be laid in the semicircular hollow of the under swage B, while the upper swage would be kept firmly pressed upon the axle bearing, so as to cause it to receive the blow the instant it was given on the top of the upper swage A. I have been the more anxious to detail this process, as it is to the effects of this swaging that we are to ascribe the majority of cases of broken axles. Not that the process is bad in itself—far

~~Fig. 4.~~



otherwise; it is only bad in its effects, provided we stop there
if we only take the trouble to anneal such a swaged axle *afte*
received the most severe compression, by swaging or hamme
low temperature (*i. e.* 60°, or thereabouts,) by simply hea
to a dull red heat, and laying it down to cool at leisure, we shoul
as in the case of experiment 3rd., have a most extraordinary
of toughness and shock-resisting quality conferred on it, in pl
such a state as detailed in experiment 2nd., with, in all prob
such disastrous results as there are but too truly sad records of.

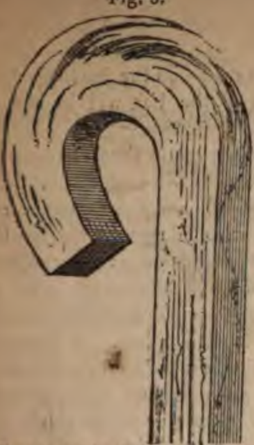
I have also been anxious to detail these experiments, as they
to me to bear directly upon the subject of railway accidents
have arisen from broken axles, in the investigation of whi
appearance of the fracture of the broken axle has been made t
terion of fitness or otherwise of the iron for such use, and in
cases the iron has been condemned in consequence, when th
truth might in all probability be that it was simply the result
hammering, without the subsequent process of annealing at a d
heat, as before named.

In the case of experiment 2nd we have what would in gene
considered evidence (so far as texture or grain of the fracture
of very fine quality of iron; but what was its actual fitness I lea
readers to judge by the result of that experiment.

With all due reverence for *scientific* research, I cannot but thin
in this subject, as in many others of the same nature, there
great a tendency to hunt after explanations of causes and mo
prevention which, as before said, we find a much shorter and
factory road to, by searching for them in our workshops rathe
in our laboratories. I trust my readers will in general agree wi
that the result of these simple experiments tends to illustrate
state on this head. Our workshops are (if rightly looked int
true schools of practical science, wherein theory may be seen
really true state, namely, accompanied with *all* the circums
which conspire to give the true result.

Experiment 4.

Being desirous to try the effect of temperature in influenci
appearance of fracture as regards crystalline texture, a part
same bar, as in all the preceding experiments, was taken and w
from 60° to 100°. Such was the effect of this 40° of additiona



~~Fig. 5.~~

that after receiving about 50 blows over the edge of the anvil, it passed into the form given in fig. the fracture being entirely *fibrous*, like wood, of a fine lead gray colour, and totally free from the appearance of any sparkling crystals. This experiment, then, warrants the conclusion, that the appearance of the fracture is also no criterion of the quality of the iron, *if temperature be left out of the question*, inasmuch as 40° has not only vastly improved the tenacity, but also wrought an entire change on the aspect of the grain of the iron. It is well known to practical men that a very few degrees of heat will most materially affect not only the appearance of the fracture of iron, but also its tenacity.

But for my reluctance to occupy more of the space of your excellent journal, I should most gladly have given farther details and experiments; but I trust such as I have endeavoured to describe will be in some degree acceptable, and be productive of useful results. I would most strongly recommend all who are interested in such matters, and who have the opportunity, to repeat the experiments themselves,[†] as I doubt not the results would not only agree with what I have found and stated, but also tend to rivet the recollection of them in their minds, as the subject is one of the very highest importance to all, especially to those whose professional character and success may be influenced by possession or otherwise of such plain workshop facts.

I have no desire to make any great claim of discovery here, but I shall feel highly gratified, if what I have brought to light as to *the vast accession of shock-resisting quality conferred on wrought iron by the combined action of cold hammering and subsequent annealing should prove, as I am confident it will, a substantial benefit to all who have either their lives or property depending on pieces of wrought iron*, whether in the case of a railway axle, or other application.

I am no advocate for over-burdening the attention of engineers with compulsory clauses in specifications, but I would most strongly recommend attention to annealing of all bolts and axles, on which much depends. The recommended process requires no extra expense or trouble worth naming, and companies would do well to see that such was attended to.

Bridgewater Foundry,
Near Manchester,
~~*Aug. 1, 1842.*~~

~~I am, Sir,~~
~~Yours most respect~~fully,
JAMES NASMYTH,

NOTES ON STEAM NAVIGATION.

Engine Frames.—The foot or projection descending from the diagonal stay to the condenser or main centre bracket is, in our opinion, superfluous and inexpedient. If the attachments of the main centre to the bottom are such as they ought to be, this projection from the diagonal stay can have no upward pressure thrown upon it; and if the bottom attachments are insufficient, the diagonal stay is unable to resist the upward pressure without injurious straining and vibration. The attachment for the main centre is best, we consider, when cast in the form of a bracket on the sole plate, as in the engines of the *Trent* and *Isis*, by Messrs. Miller and Ravenhill. The bottom part of the engines of Messrs. Maudslays and Co. consists of too many pieces: the sole plate is one casting, the condenser another, and the main centre bracket a third; and these parts have to be fixed together by bolts, and there is a joint of great superficies between the sole plate and condenser, which is undeniably a very bad thing. In Messrs. Miller's engines all these parts are cast together: the sole plate, condenser, and main centre brackets consist of only one piece which is certainly much the best system.

All the bolts in the framing for the purpose of connecting the several parts of it together should be turned with a little taper, and the holes should all be widened out. If this be not done, the framing will be very likely to work. Where there is much side strain upon the bolts they should be of steel. The soles of the plummer blocks and the places they rest on upon the frame should be planed all over; the outsides of the paddle shaft brasses, and the insides of the plummer blocks should also be planed all over; fitting strips will work into the substance of the brass, and the bearings will get slack sideways without the possibility of tightening them. Horns to the crank beams are unnecessary, if the framing be well fitted and bolted, but if adopted, should have some means of being tightened sideways as well as fore and aft, in the sockets on the beams in which the horns slide. A horizontal cross between the engines is a very useful attachment; and the connecting pieces at the end of the engines between the frames should extend upwards and downwards on the columns, so as to obtain as firm a hold of them as possible. The surfaces should all be planed, and the holes widened. A common planing machine may be made to plane sole plates, cylinder faces, or framing by fixing a bracket to carry the tool upon the carriage, and bringing the thing to be planed to the side of the machine, and there fixing it. A string attached to a ratchet operating on a screw may be easily made to move down or forward the cutter.

Valve and parallel motions.—The valve motion of one engine is identical with the piston motion of the other engine; and the parallel motion shaft of the one engine, by being extended to the other engine, might be used to work that engine's valve. A combination, too, of the motions of the two engines might be used to work the expansion valve, so that both the slide valves and expansion valves might be worked without either cams or eccentrics. To carry this out in practice it would be necessary to have a solid shaft within a hollow shaft, extending from engine to engine, the parallel motion of the one engine being connected with the solid shaft and the parallel motion of the other with the hollow shaft. The parallel motion, then, of the starboard engine would work the larboard valve, and *vice versâ*. The expansion valve might be a slide valve working on the inner flat surface of an ordinary short D, with the upper tails connected so as to form a port, and wrought by a spindle through a hollow valve rod. The motion proper to the expansion valve might be obtained from the combined or antagonistic motions of the solid and hollow shafts, which sometimes move in different directions, and at other times in the same.

The best sort of foot and discharge valves would be the slide valve, and indeed the valves of the several pumps might also be made slide valves, with much advantage. The slide valve will neither make a noise, nor get gagged with chips or dirt. By way of parenthesis, we may remark that the slide valve seems to be peculiarly well adapted for the feed-pumps of locomotives. If the air pump were furnished with a slide instead of flap valves, it might be made double-acting, and with half the size would maintain a better vacuum in the condenser than is attainable by the existing modes. There would then, of course, be no valves in the bucket, which would become, in fact, a common piston. It would be easy to work the injection slide by the engine, so as to apportion the quantity of water to the quantity of steam—a measure of each being admitted every stroke—and to make the rate of its admission more nearly identical with that of the flow of steam into the condenser. This would probably have the effect of making the vacuum steadier, and would prevent the engines from being choked with water when brought up in a sea way, if used in conjunction with a cataract.

The most convenient way of packing slide valves is from the back. The packing screws should come through a cross bar supported by proper lugs in the casing, so as to take the strain off the door, and should then extend through brass bushes rivetted into the door, and

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[*] We sincerely hope that Mr. Nasmyth will not hesitate to favour us with all the information he can upon so important a subject, and we feel assured that we are only echoing the sentiments of our readers in expressing such a desire.—EDITOR.

[†] And record them in the *Journal*.—EDITOR.

be provided with a jam nut outside, to prevent any dripping of water, or escape of steam. It is common with some engineers to let the packing project beyond the face of the valve an inch or two, little pieces being cast on the cylinder to continue the circle of the valve, and afford a support for the packing beyond the face. Messrs. Maudslays make the packing merely to abut against the face, without going beyond it. This method requires the length of the packing to be determined with great exactness previous to its introduction; and if it swivels the least on the back of the valve, there will be a vacant space at the one corner, and a double thickness of packing at the other.

The packing port should always, if possible, be opposite to the port of the cylinder, and when it is not opposite it is very important that the valve, if short D, should have the upper and under portions connected by three rods; indeed, in all large engines three rods are best. When there are only two, the valve at the extremity of its stroke is apt to bend back from the face, and will generally wear taper. The valve rod is often, in the case of short D valves, attached not immediately to the diaphragm of the valve, but to a malleable iron jaw, which is secured to the valve diaphragm. But we think it the simplest way for the valve rod to go at once through the valve diaphragm, with nuts upon the under side, and for the square pin by which the valve is moved to be supported by two brackets cast on the valve diaphragm, there being a little play left fore and aft in the square eye of the valve rod, to admit of the valve being pressed forward as the faces wear, without interfering with the stuffing box above.

Paddle centres.—We do not think favourably of the plan of boring out the eyes of the paddle centres, turning the bosses on the shafts, and fitting the centres on with a single key. When once the centres get rusted in their seats, when fitted in this way, it is next to impossible to start them, and if the vessel has to go into dock, it will sometimes be necessary to break the centres before the paddle rings can be drawn towards the sides of the ship. Nor do we think well of the plan of putting the centres on in two halves. It is almost impossible to prevent such centres from becoming slack upon the shaft, unless they be encircled by a malleable iron hoop. We like best to see the bosses on the shaft, and the eyes of the centres square; each centre made in a single piece, and fixed on the shaft by means of eight good thick and wide keys. A cut should be made with a chisel at the head of each key, so as to raise a projection on the shaft against the end of the key, to prevent it from working out. These burs can be easily cut off at any time the centres require to be shifted, and the keys, if made of proper strength and taper, may always be started without any very great difficulty. The heads of the paddle arms should be secured in sockets in the paddle centre, with keys. We do not at all like the plan of fixing the arms with bolts to the sides of a centre indented to receive them; we have never known any of this kind of centres to be in use for any considerable time without the arms becoming loose.

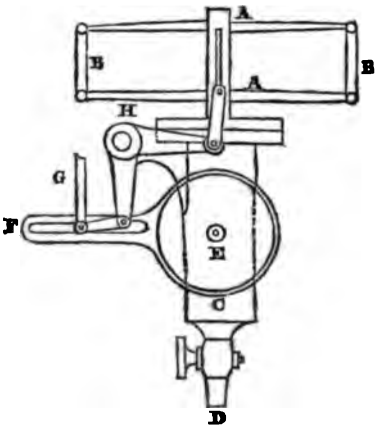
Crank pins should always be made much larger than is required for strength, else they will be very apt to heat. The crank pin of Messrs. Miller and Co.'s West India packets is 11¾; of that of Messrs. Scott and Sinclair's about 7¾. We like the crank pin to be put in from the inner side, that is, through the eye of the paddle crank, and secured by a strong screw tapped into the pin pressing upon a washer of adequate strength, which rests on the crank pin eye. We do not approve of large cutter holes through the eye and pin, by which they are much weakened; and think a single steel pin of moderate diameter, driven through the crank pin and eye, sufficient to keep the pin firm, assisted with the screw at the outer extremity.

Drag links are a useless incumbrance: the end of the pin in the loose eye of the crank should, of course, be rounded, to admit the fall of the outer end of the shaft without snapping the pin, and should be steeled, so that it may not wear very fast. There should be a removable steel or brass block in the loose eye for the pin to press against, rounded to the shape of the pin, and slipping into its place in a dovetail. This should be on the driving side: on the backing side there should be a small square block fitted into a re crank eye, and pressed against the pin by a screw with a j that there may be no back lash in the loose eye, when the the paddle-wheel. The screw should always be on the ba else the continual pressure on the point of the bolt will rivet it in.

Different modes of Propulsion.—Up to the present time t paddle-wheel is undoubtedly the best; but we have high e from a very novel plan of propulsion devised, and now in of being matured, by the Messrs. Whitelaw, of Glasgow. screw has succeeded far better than most engineers ever but it is certainly as yet less efficient than the paddle-whe understand the Great Western *cognoscenti* have adopted t their iron leviathan, and intend to drive it with a belt. horses' power and a belt! Who, after this, can refuse to indian rubber? We know not if this be an emanation of genius, or a device of the chivalrous Mr. Guppy; and we to be regretted that the public is not more specifically whom the brilliant thought is principally due. Our g certainly had but little idea of spinning-wheels on so m scale, else they might have bequeathed some hints of v import. They might perhaps have told us that belts are a and slip, when there is much strain put upon them, and th and heat and steam do not act beneficially upon leather. such legacies have been left us, and the days of spinning gone, we must now make up our minds to wait with resi issue of the Great Western experiment, though we qu whether it will be brought to an issue for ten or twenty ye We really think it would have been well for the Gre people, had they gone to Messrs. Maudslays and Field Great Western. Had they done so, they would have bee excellent vessel, she would have been afloat long ago, an be earning money.

PROFESSOR MOSELEY'S CONTINUOUS INDICATOR.

We think upon the whole very favourably of this con it appears needlessly complicated and expensive, and pe what liable to get out of order. The friction cones, we not sufficiently safe and certain in their action. A littl upon them, and a little undue friction in the machine—ac enough to occur, especially in a steam vessel—would ca to turn round, without carrying the wheel-work with them vitiate the indications. These evils in our estimation ar of a remedy, and we should propose a form of indicato after the fashion of that figured in the subjoined rude sk objectionable, perhaps, than Professor Moseley's, though pretensions to the character of a matured or unobjection



A A are the s the links conne C is the cylinde dicator; D the serting it in cover; E a ratc circled by a ring ber of internal p patent windlass nating in a leve long slot, in whi the rod, G, ma bell-crank, H, towards F, or t is connected wit and if the pin slot of the le always stationary, it would always carry round the rat distance. But when the pressure in the cylinder is i piston of the indicator is forced farther up, and the rod nearer to the centre of E, and consequently carries the ratchet round a greater distance. The slot should of course be made so that G might be carried to the very centre of E, though not so shown in the figure. Instead of a rod, G, a string with a weight or spring for bringing it back might be employed: and instead of the bell-crank, H, a chain or piece of silk or catgut, with a couple of pullies and a spring, might be used. These pullies, or one of them, might manifestly be made spiral, so as to move the pin of G out and in, according to any desired ratio; or the same effect is accomplishable by a suitable construction of the spring.

We do not think it of the least use to register the pressure of steam beneath the piston as well as above, in any double-acting engine; as, if the valves are properly proportioned, the upper and under pressures must be always the same. It is desirable to ascertain by a common indicator that the action in the up and down stroke is identical; and then the registration of the difference of pressure during one part of the stroke will be a correct indication of the engine's performance.

We are glad to find that Professor Moseley's indicator is about to be applied to the Great Western, and we anticipate vast benefit to steam navigation from its application to steam vessels in general. We trust Professor Moseley will urge the advantages of such a species of registration upon the attention of steam ship owners. It is of the last importance, and the public is greatly indebted to Professor Moseley for his successful labours in removing many of the difficulties which stood in the way of the establishment of a comprehensive and efficient system. We shall be greatly disappointed if he fails to follow these labours up, or neglects the steps necessary to render them beneficially available in practice. Some representation should be made to the Steam Association on the subject.

THE ELEMENTS OF STEAM IMPROVEMENT.

One of the most important improvements in the steam engine developed of late years is expansion; and although it can scarcely now be called an innovation, yet it has not, up to the present time, come into universal use, and where adopted, has not been carried to that degree to which it might be beneficially extended. In Cornwall, it is true, expansion has accomplished the greatest wonders, and in our largest steam vessels the most eminent benefit has been derived from its use; but in many steam vessels, expansion is very little or not at all practised, and in those in which it has been carried farthest, it has not, we think, been carried sufficiently far. We know it will be objected to, that to carry expansion much farther in steam vessels would require high pressure boilers, and that such boilers are too dangerous to be admissible. But we do not think high pressure boilers, if made as they ought to be made, in the least more dangerous than the low pressure boilers in ordinary use. On railways they are regarded without apprehension; and among the innumerable locomotive boilers in use, there has been scarcely any example of accident. There would, therefore, seem to be no good objection to locomotive boilers in steam vessels on the score of danger, and they have already been introduced by Messrs. Bury and others in river steamers with eminent success. But there is a serious objection to them in the case of sea going steamers, in consequence of the deposition of scale, which would soon prove destructive to the brass or copper tubes. This difficulty, however, is surmountable by the use of some of the contrivances already before the public for keeping the boilers supplied with fresh water; and the necessity of those contrivances to locomotive boilers, confers upon them an importance to which they would not otherwise be entitled.

There are two modes of returning the same water continuously to the boiler, so as to obviate the necessity of replenishing the boiler with water from the sea—the one is to condense the steam by the interposition of cold surfaces, the other to cool the water which has become heated by the condensation of the steam, and use it over again for the purpose of condensation. The first plan is that carried out in Hall's condensers, and in the condensers of Mr. David Napier and others; the second is known as Symington's system of refrigeration: and we think it important to inquire which of these plans is the least objectionable, and whether one of them, at least, may not be carried out in practice without giving rise to evils that will more than neutralize the benefits derivable from an extension of the principle of expansion.

The condensers of Hall require to be provided with large pumps worked by the engine; they occupy considerable room in the ship, and the weight of water and weight of metal in them are both very great. The refrigeratory pipes require to be made strong enough to resist the atmospheric pressure, and all the joints, of which there are a vast number, require to be particularly good for the same reason. These are serious objections, and another, also of considerable weight, is to be found in their expense. Condensers for engines of 300 H. P. cost several thousands of pounds, and contain about *ten miles* of pipe.

Mr. David Napier's condenser is only applicable in the case of iron vessels, and has the same disadvantage as Hall's in having the pressure of the atmosphere to sustain. It is, however, less expensive, but is rather susceptible, we apprehend, of derangement from leakage, and it is almost impossible to repair it when deranged. Symington's plan consists in leading a flattened copper pipe proceeding from the hotwell forward and aft on the outside of the ship near the bilge, so as to be always beneath the water, and out of the reach of injury either from ice, barges, or buoys, as well as from the ship taking the ground. This pipe is so made as to possess the requisite surface for cooling down the water proceeding from the hotwell to the temperature adequate for injection; and is at the same time so nicely fitted to the vessel as not to constitute any appreciable impediment to her progress. Indeed, we do not see why this pipe might not be so constructed as to form *pro tanto* the copper of the vessel, which, in effect, it would be if made with only a very small projection and a considerable depth. In Symington's plan this pipe forms the whole apparatus—there are no pumps or other machinery to work, and as the condensation is not performed within the pipe, it has no atmospheric pressure to sustain, and therefore may be made of light materials, and without any particular care in jointing. Indeed, even if there were a hole purposely made in the pipe, it is very questionable whether a drop of water would leak either in or out, the pressure within and without being just about the same.

It would be foreign to our present purpose to enter into any enumeration of the various benefits to be derived from feeding marine boilers with fresh water. It is sufficient to say that they are eminent and manifold, and involve, to a considerable extent, the question of economy of fuel. In muddy rivers, too, it is very important, after starting with clean water in the boilers, to use the same water over and over again, and we believe that, in such situations, this will be found the only remedy for priming. But these considerations, though important, are poor and insignificant compared with those which flow from an effectual extension of the principle of expansion in steam vessels, and to which the use of fresh water in the boilers is, in our opinion, indispensable.

We understand that Symington's plan of refrigeration has been applied to several steam vessels with eminent success; but one vessel to which it was applied, the *City of Londonderry*, it was subsequently removed from. This certainly looks unfavourable; yet, if the plan has been found to answer well in the case of some vessels, it is difficult to perceive why it should fail to answer universally. The most natural supposition therefore is, that the failure in the case of the *City of Londonderry* was the result of accidental circumstances, such as will often befall the best devised schemes, but which are always susceptible of rectification. As we happen to be intimately acquainted with the causes which led to the removal of Symington's apparatus in this particular instance, we shall briefly state them, partly as an act of justice to that scheme, and partly to exemplify how easily the most trivial and irrelevant circumstances may sometimes conspire to condemn and render vain even the best contrived arrangements.

Anteriorly to the application of Symington's plan, the *City of Londonderry* was an old and had always been a slow vessel: it was resolved upon to lengthen her, with the view of increasing her speed, and the occasion of this alteration was seized upon for the application of

Symington's contrivance. When the vessel was tried after having been lengthened, she was not found to be as fast as was anticipated, and the fault was thrown upon Symington's pipes for obstructing the passage of the ship through the water. These pipes were therefore taken off, but the vessel did not go any faster in consequence, and the pipes would perhaps have been applied again, had not the event of the vessel being nearly as slow as ever so discouraged the owners, that they deemed it inexpedient to go to any farther expense. Even had Symington's plan been re-applied, she would have still been inefficient for their purposes; she was therefore laid aside, and is now broken up.

It is a natural objection to Symington's plan, that the pipes on the outside of the ship are peculiarly liable to injury. In this belief we ourselves participated, but experience has proved the objection to be unfounded. The *City of Londonderry* encountered several severe storms in the Bay of Biscay, without the pipes sustaining the slightest damage; and in the other cases in which they have been applied—as in the *Dispatch*, where the plan has now been in operation for some years—no injury to the pipes has ever been found to occur. Indeed, after having given much inquiry and consideration to the subject, it is our decided belief that Symington's plan is not only the best for keeping boilers supplied with fresh water at sea, but that it is unattended with any evils or inconveniences unknown to the common method of condensation. The expense, too, is not great; the direct advantage is not inconsiderable; and the indirect advantage of such magnitude as to have induced us to give this mode of condensation so conspicuous a place in this dissertation.

Expansion is the most effectual known agency for economizing fuel; high pressure steam is indispensable for efficient expansion; and locomotive boilers are necessary to the use of high pressure steam in steam vessels with safety. The use of locomotive boilers involves the necessity of feeding the boilers with fresh water, and this is best to be accomplished by Symington's plan of condensation. It is also expedient that the locomotive boilers used in steam vessels should be provided with some species of self-acting feed, as the quantity of water in such boilers being small, the water level, without some such expedient, will be liable to great and sudden fluctuation. But upon this topic we are now unable to enlarge, and must reserve its consideration for our next number.

CANDIDUS'S NOTE-BOOK.
FASCICULUS XL.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. GEORGE ROBINS most assuredly did not consult Welby Pugin, when, in his late advertisement of the sale of Weddington Castle, he spoke of Lugar as "an artist possessing a perfect knowledge of Gothic architecture." No doubt he would say just the same of any one else who had built a castellated pigstye, which was to be knocked down by his hammer. George is privileged to puff—no matter how impudently—for it is his vocation. But it is lamentable to see the same sort of nauseous puffery indulged in where there ought to be something like reasonable opinion assigned for the praise that is bestowed. It is a pity that, instead of an Income-tax, a tax was not levied on superfluous and nonsensical epithets. "Splendid" and "Elegant" have been so bandied about of late as to have lost all their value, and almost their meaning, too. In some cases—and those not a few—they might be supposed to have changed their meaning altogether, and to have become synonymous with "paltry" and "trumpery." With advertisement and paragraph writers everything is, in fact a *trump* card: they have nothing but trumps dealt to them, and they themselves deal in nothing but trumpetting. Even the *Times* has lately got hold of a penny-trumpet—that, perhaps, of some penny-a-liner—with which it has been squeaking out the praises of one or two publications, which formerly, supposing them to have then appeared, it would not have condescended to notice at all.

II. Mr. Moxhay seems to resemble Lord Byron, inasmuch as, on waking a few weeks ago, in the morning, he found himself suddenly become famous. Within the last month, his name has appeared and his building has been spoken of in almost every newspaper, and that in a manner more flattering to both, than to some of the "Dons" in the profession and their handyworks. Not a few have been the peregrinations made to Threadneedle Street, by artists and people of taste, for the express purpose of viewing a piece of architecture whose character is so remarkable, on account of the exceedingly important share which sculpture has in it. The artist employed upon the last has performed his task with more than ordinary ability, and has produced what will bear deliberate examination as a work of art—as something more than so much ornament, intended merely to aid the general effect. Whether what has been here done by a private individual will have the effect—either general or partial—of introducing sculpture into architecture, as a more important feature in it than it has hitherto been made in this country, it would be as hazardous to prophecy as it was to predict the London earthquake.

III. It is justly remarked by the writer of the "Spirit of Architecture," that the engineer—and, he might have added, the builder—is now treading upon the heel of the architect. Well, let us then hope that those who bear the latter title will feel spurred on thereby, and endeavour to rouse themselves from their lethargy—from the drowsy system of giving us literal copies of a few of the forms or parts belonging to the style professedly adopted. At the best they show themselves no more than mere copyists, unable to think for themselves, or to get on at all without incessant prompting: nor is it unfrequently they betray how utterly ignorant they are of the real character of the style they profess to follow. In fact, as far as they study style at all, very many seem to have no other notion of doing so than merely by piecemeal, and in fragments. They can pore over its separate bits—they have its alphabet tolerably well by heart; but farther than that they are either quite unable to get, or too indolent to strive to advance. They take no *grasp* of any style; they do not attempt to make themselves masters of it. Perhaps, after all, no wonder such should be the case; for if the study requisite for attaining a complete knowledge of style, composition and effect, be not felt to be a delightful pursuit, it must be felt to be a confounded bore. The *bored* or *wooden-boards* will content themselves—what a virtue is content!—with what they can pick up out of "Stuart," and other works of that kind. But they would also do well to reflect—if only because it may touch their own pockets—that they are not exactly the patentees of the works they make use of so very liberally, and study very scantily. The engineer and the builder can take a leaf out of them, just as well as themselves, and thereby become every inch as classical. Little occasion is there for an architect for such things as the York and the Nelson column, when an engineer would do quite as well, perhaps even better. Little occasion, too, is there to employ a sculptor, when anything rough-shaped into the form of a man will serve for the statue that is to be hoisted up to such a height as to render seeing it out of the question.

IV. It is somewhat singular, that while polychromy has been adopted at Munich for one or two buildings, the Ionic monopteral temple in the "English Garden," the Post Office, and Great Theatre, the throne-room of the palace should be entirely white and gold; although a very good opportunity was there offered for trying the full effect of polychromic architectural decoration precisely after the antique fashion, by decorated colouring and painted enrichments applied to the mouldings and surfaces of the various architectural members. Probably the monochrome or achromatic style of embellishment adopted for this apartment was intended to contrast with the rest, all of which are painted with subjects in fresco; which last circumstance, and that of the rooms being throughout of nearly the same size and shape, occasion a degree of monotony that it would have been better to avoid. No "Episodes of Plan" are to be found in the Neue Residenz at Munich, though the throne-room itself admitted of being rendered a rather striking one, since its purpose admitted a form being adopted for it that can very seldom be introduced at all. So far from being inconvenient, a semicircle, with the throne placed on the chord or straight of the room, either between columns, or within a tribune forming a smaller semicircle, would have been better adapted to the particular purpose than any other shape. It would then, too, have been manifest at once that the room was especially intended to be and to remain what it actually was, and that it had been planned expressly for the use to which it was applied, and for no other.

V. Wolff's remarks on the Berlin Museum are one of the ablest and most interesting pieces of architectural criticism I have met with for some time—searching, and perhaps a trifle too hypercritical, but the building itself is one that will bear a little more probing than usual. As to *probing*, it is not every critic who can perform the operation dexterously; neither is it every architect who relishes the idea of its being performed upon himself. Well, therefore, would it be, were architects to anticipate critics, and thoroughly probe their own designs in the first instance, with an unflinching hand; at least, well consider what objections are likely to be made by others, and whether they can be at all parried.

VI. There is a note to an article upon Greece in the last No. of the Quarterly Review, which stimulates curiosity not a little; for it mentions a "magnificent" work by Demidov on the Remains of Grecian Architecture, but without specifying anything farther than that the text is in Russian, unaccompanied by either a French or English translation of it. Whether it is worth translating in itself, is more than the writer in the Quarterly can tell, for he confesses his inability to judge of more than the plates; yet he might as well have mentioned the date, and something that would have served as a clue to others, in making inquiries relative to a work not likely to be met with by mere accident. It does not follow that because the reviewer himself could give no account of it, no one else can; and at any rate he might have extended his note, and said something of the engravings, since it is to them, it may be presumed, that the work is mainly indebted for its "magnificence." As it is now some time since the Quarterly Review has favoured us with any architectural paper, it would do well to found one upon M. Demidov's work; for if there is anything fresh in the plates, there is in all probability some original matter in the text—perhaps some original remark also, and if so, it is quite as deserving of being communicated to the readers of the Quarterly as Fanny Burney's "small-beer chronicles" about herself and the "sweet Queen." It is to be hoped that Queen Victoria has no such chroniclers and diary-keepers about her person. The court newsman gives us quite enough of "small-beer" doings at the palace.

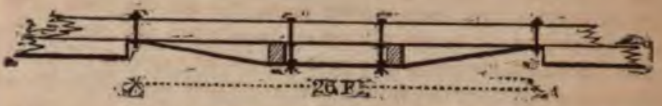
ON THE STRENGTH OF TRUSSED GIRDERS.

(From the American Journal of the Franklin Institute.)

Details of some Experiments upon the Comparative Strength of Trussed and plain girders of wood, made at the Philadelphia Exchange, during the construction of that building in 1832. By John McClure and Ellwood Morris, C.E. *Reported by the latter.*

The experiments which have been made upon the relative strength of girders, trussed and untrussed, are so few—that the following details may be found interesting to persons engaged in construction; particularly as the mode of trussing by suspension, therein tested, is becoming more and more extensively used in this country, and is really susceptible of being made very serviceable in many situations.

These experiments were undertaken with the view of ascertaining the proximate value of wrought iron suspension trusses for girders, which were about that time brought forward conspicuously here, as a new and useful improvement in carpentry; though at least in one instance they had been used many years before in this country; viz., by Lewis Wernwag, the celebrated carpenter,[*] who applied suspension bars, one and quarter inches square, to stiffen the main longitudinal floor beams of the bridge over the Neshaminy creek, in this state, which was built by him in the year 1808. (See the annexed sketch which represents a side view of the suspension truss used in the bridge referred to.)



We have taken the pains to ascertain from Mr. Wernwag himself the date of the construction of the Neshaminy bridge, as it carries the application of the suspension girder truss somewhat further back into past time, than has heretofore been expected; though the writer has lately been informed by a gentleman distinguished for his antiquarian researches, that such trusses were in use upon the continent of Europe even antecedent to that time.

The now recorded history of the wrought iron suspension truss for girders, as far as known to the writer, is as follows:—"In 1821, Mr. R. Stevenson, of Edinburgh, designed a bridge for the river Almond, in which the principle of supporting a roadway by iron bars passing underneath, was first adopted."[*] In 1822 the same principle was recommended by Mr. H. Palmer, to be applied in carrying his railway, of a single line, over streams or vallies.[†] In 1824 Mr. A. Ainger submitted a suspension trussed girder to the Society for the encouragement of Arts; to which we shall presently more particularly refer, and which was successively applied to practice. In 1828 girders trussed by suspending rods were used with manifest advantage in several buildings, by Mr. Joseph Conder, who claimed the merit of their invention, as did also Mr. A. H. Renton, Civil Engineer.[‡] All these gentlemen, however, without their knowledge, had been anticipated in this matter by Wernwag, at the Neshaminy bridge, as before mentioned.

In addition to the above, the writer may state that in 1833 he examined a wrought iron suspension truss, which had been applied some years before, on a large scale, to uphold the central parts of Flat Rock bridge, (of 198 feet span,) over the Schuylkill river; which bridge—constructed with *very slender* curved ribs of three inch plank—had at that time yielded considerably, and since has fallen down. In 1834 he measured a horse bridge (built by Wernwag) upon the Chesapeake and Ohio Canal, near Harper's Ferry, of 52 feet span, which was trussed like fig. 1, the horizontal bar being 26 inches clear of the underside of the outer floor beams, which rested each upon two inverted queen posts of iron, diagonally braced against lateral motion, and rising, as it were, from the angular points *b* and *c*. This species of truss has, since that time, been applied to strengthen the girders of a number of bridges in the United States, to which it is unnecessary now to refer.[§]

Returning from this digression, into the recent history of suspension trussing; we will now repeat, that in the Franklin Journal for 1832, the description of a mode of trussing girders with wrought iron rods, acting upon the suspension principle, was extracted from the "Transactions of the Society for the encouragement of Arts," and accompanied by two wood engravings.

The plan alluded to was devised by Mr. Alfred Ainger, and submitted to the Society in 1824, who after investigating the merits of the plan—trying some experiments upon models—and witnessing its successful application in buildings—finally testified to Mr. Ainger, their sense of the merit of his contrivance for strengthening beams, by formally awarding to him the thanks of the Society. Mr. Ainger's truss, as applied to a girder of 34 ft. span, consisted of two sets of iron rods, (one on each side of a single beam of timber,) secured by screws and nuts, to abutment plates, notched upon *the upper side* at the ends; these rods descended so low as to admit of two supporting plates being inserted between them and the beam, and forced up against its underside by the end screws, so as to give to the girder two intermediate points of support; thus dividing the whole span into three bearing spaces of equal extent; the side view closely resembling fig. 1. This girder is described as having answered very well, it is stated to have carried a leaden flat for two years, without sensibly altering its form. Mr. Ainger also recommended that notches should be cut in the upper side of the beam extending to one-third of its depth, and filled "with thin wedges of hard wood or metal, forcibly driven in," so as to augment its strength and stiffness, by putting its upper side in a state of compression before being loaded.*

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[*] Mr. Wernwag, a German by birth, immigrated here in 1788, and is the mechanic who designed and constructed the famous timber bridge of 340 ft. span, over the Schuylkill river at Philadelphia, (recently destroyed by fire,) besides many other wooden bridges of magnitude and importance, in various parts of the United States.

[*] *Civ. Eng. and Arch. Jour.*, for Oct., 1841. "Description of the Foot Bridge over the river Whitadder, at Abbey St. Bathans, Berwickshire; by J. R. Wilson."

[†] Palmer's "Description of a railway on a new principle," London.

[‡] Reg. of Arts, 2nd series, vol. ii, London.

[§] In connection with this branch of the subject, we must not omit to add the following, from the same paper of Mr. J. R. Wilson, (*Civ. Eng. and Arch. Jour.*, Oct. 1841,) already quoted.

"In 1833 a bridge was erected on the tension bar principle over an arm of the lake of Geneva. It has 13 openings, of 55 ft. span, and is 25 ft. broad. The same plan has been adopted for two foot bridges of 138 and 81 ft. span respectively, erected several years since over the river Ness, near Inverness; and also for a bridge over the river Whitadder, in Berwickshire, at Hutton Mill, designed by Mr. Jardine, of Edinburgh, which consists of three openings of 50 ft. span. Mr. Smith, of Deanston, has erected a foot bridge of this kind, 103 ft. span, near Donne; and has also applied tension rods very successfully, for supporting the floors of Deanston cotton works, where they have been in use for many years."

It was the article above referred to which first drew the attention of the writer to this particular subject, and induced him, in company with Mr. McClure, to undertake, in the year 1832, a few experiments upon model girders.

These models were accurately made under the direction of Mr. McClure, and were *five in number;* each was composed of two parts, or flitches, so united as to bear a strain together; each side, or flitch, was 53 inches long, 1·75 inches deep, and 1·16 inches broad, having together a sectional area of 4·06 superficial inches; and all the models were made of clean, straight grained, and well seasoned *white pine;*† numbers 1, 2, and 3, were from the same plank, and Nos. 4 and 5 from timber of the same lot and quality.

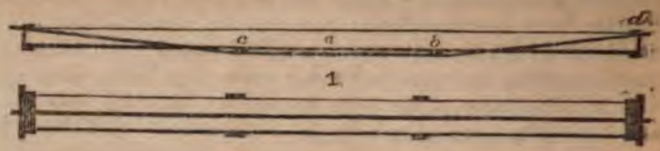
Model No. 1: Was trussed in a mode similar to that prescribed by Mr. Ainger; a single wrought iron rod exactly one-fourth of an inch square, being secured upon the upper side, at both ends, by quarter inch square pins, resting horizontally upon abutment plates one-twelfth of an inch thick, which embraced each end of the girder; this rod descended between the flitches so low as to admit the insertion of two bearing plates, *b* and *c*, fig. 1, which were forced in between it and the underside of the beams, at equal distances from the ends, and from each other, so as to give to the girder a small camber. (See plan and section, fig. 1.) And, in addition, 34 equidistant cuts were made in this model, to a depth of one-third of the whole, and tightly filled with thin pieces of hard oak well driven in.

Model No. 2: Was similar to No. 1, (fig. 1,) in all respects except that the hard oak wedges were *omitted.*

Model No. 3: Was a plain stick, formed by nailing the two flitches together, side by side, with four nails in the centre line, (see fig. 2, side view.)

Model No. 4: Was a girder trussed exactly like Nos. 1 and 2, except that *a central bearing plate,* one-sixteenth of an inch thick, was inserted between the beam and truss rod at *a*, fig. 1.

Model No. 5: Was a girder trussed in the common way—with one king bolt, two iron abutments, two hard oak braces let into each flitch nearly one-eighth of an inch—and keyed up to a slight camber. (See fig. 3, which shows the girder with one flitch removed.)



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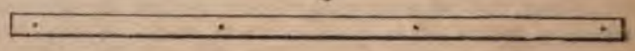

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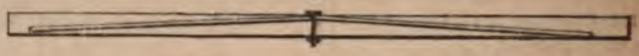

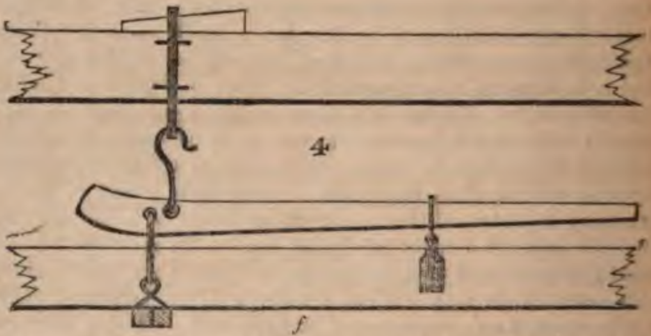

4

All of these models were put under strain in the same manner, their own weight being counterbalanced; viz., by resting them against two fixed supports, exactly 50 inches asunder, and applying the straining force, by a vertical pull upwards, through an iron stirrup with rounded edges, slipped over the model—which was turned bottom up—and attached to the shorter arm of an accurate steelyard, which weighed up to 1,288 lbs.; and the successive strains were put on by moving the weight of the steelyard, as in weighing, so as to add usually 56 lbs. at a time; the beam of the steelyard being adjusted to a level at each addition of strain, and the deflections being carefully measured—from a fine string joining the extremities of the models—by a diagonal scale to hundredths of inches. (See fig. 4, which gives a general idea of the experimental apparatus, *f* being a girder under trial.)

The subjoined tabular statement exhibits, at one view, the results of the trials of the strength of the several model girders; which it will be recollected, were all of precisely the same scantling and bearing length.

It must be observed that our steelyard not having sufficient power to break model No. 4, it was subsequently broken by a lever, in order to ascertain the position of *the neutral axis of fracture.*

The five following results were common to all the models when broken, and though similar to what have been observed by other experimentalists, they may as well be stated.

1. *The neutral axis of fracture,* occupied precisely the same place in all, being at four-sevenths of the whole depth down from the top, or one-fourteenth below the middle, (Barlow's experiments on *fir beams* fixed it at five-eighths of the depth, which is nearly the same.)

Giving, area of fibres	*crushed,*	2·32	square inches.
Ditto	*torn asunder*	1·74	"
Total sectional area in superficial inches		4·06	

2. The first indications of fracture, always appeared on the upper side, by the fibres *crushing.*

3. The signs of crushing at the time of fracture could be traced each way from the centre some five or six inches.

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* This was conformable to the results of some experiments by M. Duhamel, who showed that when a bar of *soft wood,* such as willow, was cut one-third through from the upper side, and this cut filled with a thin piece of *hard wood* stuck in pretty tight, *its ultimate transverse strength was thereby increased about* 10 *per cent.* (Barlow's Essay on the Strength and Stress of Timber, 3rd. Edit., 1826.)

† This is the *Pinus Strobus* of Michaud's North American Sylva (vol. iii, p. 159), the loftiest tree of the American forest; it is employed here for an immense variety of purposes, and is one of the most valuable timbers which we possess. It is called *Weymouth Pine,* in Tredgold's Carpentry; and we may here remark that the concurrence of three of our experiments indicates that the ultimate strength of the white pine, used in our models—which was of the best quality supplied by the lumber market of Philadelphia—did not exceed 868 lb. for sticks of the scantling, and length of bearing, used by us. Wherefore the constant quantity *c*, of the table in Tredgold's Carpentry, (2nd Edit., London, 1828, p. 56,) calculated by the formula $= \frac{W\ L}{b\ d^2}$ would be 509 instead of 658, as Tredgold has it, which last is certainly too high a number; for the breaking weight of our plain stick, (model No. 3,) if calculated by it, would have been 1122 lb., instead of 868 lb., (as we actually found it to be,) *or thirty per cent more.*

4. The deflections within the limit of elasticity, were (very nearly) equally increased by the addition of equal weights.

5. The place of the neutral axis of fracture, was most distinctly marked in every case, and the section of fracture, in all the models, very closely resembled that shown in Plate III of Barlow's Essay on Timber, 3rd ed: London, 1826.

The elastic strength of Model	No. 1,	did not exceed	392 lb.
do.	No. 2,	do.	560
do.	No. 3,	do.	560
do.	No. 4,	do.	1120
do.	No. 5,	do.	840

As indicated by the breaking weights, excepting only No. 4, which would have borne a few more pounds; and No. 5, which would have broken with less, *if time* had been allowed.

The ultimate strength of Model	No. 1,	was	868 lb.
do.	No. 2,	„	868
do.	No. 3,	„	868
do.	No. 4,	„	1288+
do.	No. 5,	„	1176−

Statements.	Weight applied in pounds.	Girder No. 1. Trussed with iron rod, and wedged along compressed side. See fig. 1.		Girder No. 2. Trussed with iron rod, but without the wedges of No. 1. See fig. 1.		Girder No. 3. Plain stick without trusses. See fig. 2.		Girder No. 4. Trussed like Nos. 1 and 2, but with the addition of a *centre plate* at *a*. See fig. 1.		Girder No. 5. Trussed with wood in the common way. See. fig. 3.	
		Deflection in inches.	Remarks.	Deflection in inches.	Remarks.	Deflection in inches.	Remarks.	Deflection in inches.	Remarks.	Deflection in inches.	Remarks.
1	56	c·20	Original camber ·31 in.	c·15	Original camber ·20 in.	·09	Original camber ·0 in.	c·14	Original camber ·19 in.	·05	Original camber ·05 in.
2	112	c·06	Stood level with 140 lb.	c·09	Cambers marked c.	·16		c·09	Cambers marked c.	·10	Stood level with 28 lb.
3	168	·09		·00	Stood level with 168 lb.	·27		c·05		·17	
4	224	·22		·04		·37		·00	Stood level with 224 lb.	·25	
5	280	·40		·12		·47		·04		·32	
6	336	·55	364 lb. remaining on for 10 min. increased the defl. ·12 in.	·19		·57		·08		·41	
7	392	·80		·28		·65		·14		·47	
8	448	·94	At 8 unloaded returned to a camber of ·10	·37		·75		·21		·55	
9	504	1·13		·47	At 9 unloaded returned to a camber of ·12 in.	·83	At 9 unloaded returned [to level.	·29	At 9 unloaded returned to the original camber.	·64	
10	560	1·40	532 lb. remaining on 5 min. increased the defl. from 1·27 to 1·3	·64		·93	Ditto.	·37		·71	
11	616	1·68	At 11 unloaded returned to a deflection of ·18 in.	·77		1·07		·46		·79	At 11 unloaded returned to level.
12	672	1·98		·89	Upper fibres begin to crush.	1·19	Upper fibres begin to crush.	·53		·95	
13	728	2·21		1·00		1·35		·61		1·02	
14	784	2·50		1·20	Appearance of crushing extends rapidly.	1·51	Crushing fast increased.	·69		1·12	At 14 unloaded returned to level.
15	840	2·80		1·50		1·76		·77		1·18	
16	868	3·00	Broke with 868 lb. (or 7 cwt. 3 qrs.) ultimate deflection 3 inches.	1·75	Broke with 868 lb. (or 7 cwt. 3 qrs) ultimate deflection 1¾ inches.	2·50	Broke with 868 lb. (or 7 cwt. 3 qrs.) ultimate deflection 2½ inches.	·82	At 16 unloaded returned to a camber of ·08 in., no signs of fracture.	1·25	
17	896							·87		1·46	At 17 considerable signs of crushing appear.
18	952							·92		1·61	
19	1008							1·00	At 19 unloaded returned to a slight camber, though signs of crushing begin to appear.	1·76	
20	1064							1·10		2·07	At 20, splinters on the underside.
21	1120							1·21			
22	1176							1·40		2·50	Weights briskly added, fracture takes place at 22, ultimate deflection 3 in. Breaking weight =10½ cwt.
23	1232							1·56	Signs of crushing increase.	3·00	
24	1288							1·75	Rested here for want of weight, and unloaded returned to a permanent defl. of ·16 in.		

A comparison of the tabular results will show:

1. That, contrary to the experiments of Duhamel, wedging the stick upon the upper side to one-third of the depth, with slips of hard wood—at least in the extent to which we carried it—neither augmented nor impaired *the ultimate strength* of the timber, while it diminished its *stiffness*.

2. That the suspension truss, though it added to the *stiffness*, had no effect whatever, upon the *ultimate strength*, when only *two bearing plates*, (as *b* and *c*, Fig. 1,) were used, and the weight applied midway between them.

The reason of this appeared to be, that the deflection between the bearing plates, when added to the compression of the timber, at these, and at the abutments, allowed the beams to bend enough to exceed the deflection due to their elastic strength, before the suspension truss came fairly into action.

3. That the suspension truss, *with a centre plate* applied at *a*, Fig. 1, *doubled the elastic strength* of a plain girder of the stated dimensions, *and added near fifty per cent. to its ultimate strength.*

4. That trussing a girder with hard wood, in the usual manner, increased its *elastic strength* fifty per cent. and its *ultimate strength* about thirty-five per cent.

This last conclusion is nearly the same as that developed by Professor Barlow, in experimenting upon a similar truss. (See Treatise on the Strength of Materials: London, 1837, page 165.)

The experiments referred to, and of which we subjoin a synopsis, showed that though there was no efficacy at all, in a common girder truss, *of three pieces of hard wood, with queen bolts*,—indeed, that it was weaker than an untrussed stick,—still, the truss of *two pieces, with a king bolt*, similar to that of Fig. 3, *did add considerably to the strength.*|

Synopsis of Barlow's Experiments on the Strength of Girders of Wood.

No. of Experiments.	1.	2.	3.	4.
	Inches.	Inches.	Inches.	Inches.
Distance between the Props	68	68	50	50
Depth of Girder	2	2	2	2
Breadth of Girder	1⅞	1⅞	1⅞	1⅞
Ultimate deflection	2·25	1·55	1·50 +	1·00 +
Ultimate weight in lb.	500	500	953	717
Trussed or untrussed	Trussed.	Untrussed	Trussed.	Untrussed
Broken or not	Not brok.	Not brok.	Broke.	Broke.

Nos. 1 and 3 were trussed conformably to plate 39 of Nicholson's Carpenter's New Guide, the former being a model of a girder of 34, and the latter of 25 ft. span.

No. 1 was *a queen bolt truss, of three pieces;* No. 3 was *a king bolt truss of two pieces*, similar to Fig. 3, and the weights were applied in the centre, or over the angular point of the latter truss, and midway between the queen bolts of the former.

Hence it appears that whilst the queen bolt truss, No. 1, was actually weaker than the untrussed stick No. 2, the king bolt truss No. 3 was 33 *per cent. stronger* than the untrussed stick No. 4, of the same dimensions, and similarly strained.

Our experiments on model No. 5, which was trussed nearly in the same manner ar Barlow's No. 3, display *an augmentation of* 35 *per cent.* over that of an untrussed beam.

The close agreement of our results with those of Barlow, probably justifies the declaration that—at least whilst they are new—*the common wooden king bolt trusses add one-third to the strength of the girders to which they are applied.*

Tredgold, however, in his invaluable treatise upon Carpentry, (2nd. Ed., London, 1828, p. 79,) says that "The methods in general adopted (for trussing girders) have the appearance of much ingenuity, but in reality they are of very little use." And again—"The defects of ordinary trussed girders are very apparent in old ones, as it is not simply strength that is required, but the power of resisting the unceasing concussions of a straining force, capable of producing a permanent derangement in a small surface at every impression."

As the tendency of time is undoubtedly to impair the efficiency of all sorts of trussing, and especially of those which—like girders trussed within their own depth—have *very obtuse supporting angles;* more extended experiments and farther observations are necessary to settle definitively the question of strength, between beams trussed within themselves with timber, and plain sticks of the same bearing, and scantling.

In 1828, Mr. J. Conder, soon after applying in practice the suspension truss *of two angular points*, (see Fig. 1,) seems to have become satisfied that it was defective; for he soon brought forward, as a great improvement, the idea of forming the truss with but *one angular point*, like Fig. 3, inverted; and it will be remembered, that in our experiments we were unable to procure any benefit from the suspension truss, nntil by the central bearing plate at *a*, Fig. 1, we had, *in effect*, reduced that truss to one of *a single angular point.*

In trussing a girder, the main object is to strengthen the weakest point—which is the centre of the beam—and as Barlow's experiments upon direct *queen bolt trusses*, and our own upon inverted or suspension trusses, *of two angular points*, indicated that no advantage was derived from either, when strained in the middle, we are strongly disposed to conclude, that whether the truss acts by tension or by compression, it should (in most cases) *have but one angular point.*

In support of this view, the writer may state that he has seen a number of suspension trusses of two angular points—attached to the girders of bridges—which, on close examination, indicated that they bore but little strain; whilst those with but one angular point, which he has had an opportunity of examining, seemed, in most cases, to be acting with much greater efficiency; this matter, therefore, seems to be of sufficient importance to justify our soliciting to it the attention and consideration of professional men.

Philadelphia, April 28th, 1842.

St. Rollox Chimney.—This chimney is now finished. This extraordinary work was constructed under the superintendence of Mr. Andrew Thomson, the able engineer. The extreme height, from the ground to the copestone, is 450 ft.; and, rising from a base forming the highest table-land of the city, the stalk is seen from a great distance in the surrounding country. In relative height, independent of the elevation of its base, it is little inferior to the loftiest superstructures in the world; in absolute height, it towers into the air incomparably higher. The great pyramid, Cheops, rises 498 ft., but this includes a base of 150. The Strasburgh Cathedral is 474; St. Peter's, in Rome, from ground to pinnacle, 450, being exactly the altitude of the *monstre* chimney; St. Paul's, in London, 370. The base of the chimney under ground is 46 ft. in diameter; at the ground 40; and at the top 13 ft. 6 in.

THE ROYAL ACADEMY'S TREATMENT OF ARCHITECTURE.

SIR—Neither "The Architect" nor "Ego Quoque" is, I suspect, the only one, by a very great many, who have cause to be dissatisfied with the manner in which architectural drawings are treated and disposed of by the Hanging Committee of the Royal Academy—to say nothing of the dissatisfaction given to those who go to look at, as well as to those who send, subjects of that class. Now, though I do not pretend to be able to suggest any "*reasonable excuse*" for that Committee or the Academy, their mode of proceeding being in itself altogether unreasonable and irrational, I can point out what I conceive would tend to abate, if not entirely correct, the inconveniences now complained of.

It is almost hopeless to suppose that the Royal Academy will reform any part of its system out of deference to public opinion. Your own Journal and many others have repeatedly animadverted on the very preposterous manner in which drawings are put up in the Architectural Room, many quite insignificant or uninteresting in subject obtaining comparatively good places, while others, far more worth looking at, are thrust where they can scarcely be seen at all; which is surely absurd enough, for if the space allowed to that department of the exhibition is so inadequate at the best, all the greater necessity is there that it should be turned to the best account—that the drawings admitted should be chosen with careful regard to their intrinsic merit and interest, and that since they must needs be comparatively limited as to number, they should also be select, and also still fewer than at present, no more being admitted than what can be properly hung up—that is, than can be properly seen and examined after they have been hung up. Frequent, however, as have been the complaints and remonstrances in regard to the utter want of good management with respect to architectural drawings, the Academy does not pay the slightest attention to them, doubtless because they are not brought before it in such formal manner as would render it impossible for some notice not to be taken of them. What I would, therefore, suggest is, that the Institute of British Architects should take up the matter in behalf of the profession, and formally communicate on the subject with the Royal Academy, urging the necessity for some reform and improvement in its exhibitions of architecture, and devising measures whereby such reform might be secured, as far as circumstances will at all permit. Let the Institute do this, the Academy would then be compelled to return some kind of reply; and however unsatisfactory the result might prove, at any rate the Institute itself would have shown a disposition to stand up for the interests of architecture and its professors, whereas the Academy's own professor of architecture does not seem disposed to interfere at all, but to leave the painters and the Hanging Committee to have it all their own way. I shall, no doubt, be told that what I have suggested is pretty much like the notable receipt for catching birds by putting salt upon their tails. I have proposed that the Institute should poke up the Academy; very good—but then who is first of all to poke up the Institute itself to do any thing of the kind. It surely cannot be required to be told that there is occasion for something being done in order to put the annual exhibitions of architecture upon a much better, and I may add, more respectable footing than they now are; and if the Institute has hitherto not thought fit to interfere in any way, though for such laudable purpose, is it to be imagined that it will do so now at the suggestion of any one else? Hardy! no matter; it must at least do one thing, disposed or not, for its silence will be equivalent to a tolerably plain avowal that it is determined to give itself no trouble, to listen to nothing proposed by others, more especially if what is so proposed does not immediately affect itself; therefore it must, at any rate, let it be seen with how much or how little public spirit and generosity it is actuated, and how far anxious to exert what influence it may possess for the benefit of the public and the profession.

I remain, &c.
CORRECTOR.

THE PROPOSED NEW CHURCH, KENTISH TOWN.

SIR—As Mr. Bartholomew expressed himself in his "Specifications" in no very measured terms relative to his brother architects, stigmatising the whole profession *en masse*, not only for their incompetence, but for various malpractices amounting to fraud, or what he terms *Fauntleroyism*, he has no right to look for much indulgence; nor can he reasonably be surprised if he now finds his own pretensions rather sharply scrutinized. Possibly he may be the only immaculate member in a profession in which—if we are to take his word for it—it would require the lanthern of Diogenes to discover an honest man in broad daylight; and so far he may be an honour to it. With that amount of praise, or rather self-praise, he ought, however, to content himself, for he is not likely to obtain much in addition to it.

Two lithographs have lately appeared, purporting to be an Exterior and Interior View of the Proposed New Church, Kentish Town, St. Pancras, inscribed "Alfred Bartholomew, Esq. F.S.A., Architect, Warwick House, Gray's Inn," which unusually minute piece of information looks somewhat too much like an advertisement or shop-card, were it not for the insertion of the "*Esq.!*" Still that is merely matter of taste, though too much à la John Britton, yet hardly in worse taste than the design itself, which is one of the strangest jumbles conceivable both as to style (Gothic) and as to the very inequality of character, for while in some respects it is ostentatiously showy, in others it is deplorably mean and insignificant. The exterior and interior are strikingly at variance with each other; the former—at least its front, looking at first sight more as if intended for that of a cathedral than of a moderate-sized church, while the interior is homely even to shabbiness, besides being, in point of design, hardly a degree better than carpenter's or Strawberry Hill Gothic. There is no unity of principle; nor does Mr. B. seem to have paid any regard to such economic management of the funds at his disposal or intended to be raised, as would have produced a tolerably consistent keeping up of character throughout. It now looks as if he had found out that nearly all the money would be required for the front of his building, scarely any being left for the rest of it; he would therefore have done well to have retrenched from what now seems strange extravagance there, bestowed some decoration, or even some tolerable finish as to detail, where it is now evidently wanting, and that in a very disagreeable degree. If instead of two towers and spires, he had contented himself with one, he would have been able to bestow some panelling on the fronts of the galleries, and to pay more attention to detail generally within the building. Neither would the exterior itself have suffered by such retrenchment, for at present the front seems too crowded up and overdone; and the little projection — apparently intended for a vestry — between the porches in the lower part of the towers, is a feature that, so far from agreeing with the rest, either as to style or any thing else, is no better than an eye-sore, and looks paltry in itself, and throws the whole out of keeping. As to keeping, however, that seems to have been scarcely attended to at all; for as far as the side which is seen can be made out, thrown so much as it is into perspective, the front is a mere mask to the rest, the character there aimed at being carried on no farther. In fact, as shown by the interior view, the side windows have neither mullions nor tracery, but are mere holes in a wall, and that none of the thickest. Whether it be owing to bad drawing or not—and the perspective at least is strangely incorrect—the whole of the interior has a very disagreeable look, it being not only very plain, but remarkably poor in character, with at the same time a good deal which is fantastic—for instance, the small round windows over the pillars that support the arches. The whole, in short, has a singular, meagre, starved appearance, altogether different from that sober style which might excuse or might readily be excused by economy. If such very rigid economy is thought necessary for this part of the building, why is there so much tawdry parade and pretension in the exterior? It is surely not at all in accordance with what either judicious economy of design, or the commonest rules of good taste, would dictate.

No doubt my remarks will be thought no more agreeable and liberal in feeling by Mr. Bartholomew, than were his own wholesale aspersions of the profession, by his brother architects. Still they are such as he may profit by, unless he should find, upon further consideration, that he can really produce nothing better than this lame abortive design. At all events he will perhaps now learn to speak with a little more reserve if not respect of others, since he has certainly not shown himself to be at all superior to them in talent.

I remain, &c.

AN ARCHITECT.

THE INSTITUTE AND ITS TRANSACTIONS.

SIR—Since no notice was taken of it in the review of the "Transactions of the Institute of British Architects," allow me to make some comments on what struck myself most forcibly, on looking at the title-page. I mean the appearance of Messrs. Longmans' names as the publishers. I have nothing whatever to object to that highly respectable house, and had they been appointed publishers in the first instance, no exception could have been taken at it; but it does look like an exceedingly strange "transaction" on the part of the Institute, that they should have taken the work out of the hands of its first publisher, and placed it elsewhere—that publisher being one who is in a manner identified with the architectural profession, who has done so much in undertaking and bringing out works that might else never have appeared, and who is therefore justly entitled to all the countenance and support the profession as a body can show him.

Putting aside all reference to that individual, it certainly does seem —to myself, at least—very ungracious and impolitic in that body which represents—or would, in the eyes of the public, appear to represent—the architectural profession and its interests, to withdraw from Mr. Weale almost the only compliment they could show him; more especially after receiving from him as presents, from time to time, books to which it would have become them to have been subscribers and purchasers! Call you this backing your friends? Is this the way to promote enterprise in a branch of publication which, standing as it does upon a very different footing from that of general literature, requires more than ordinary encouragement from those whose studies are aided by it? Probably the Institute may have made a "better bargain;" by acting as they have done, they may have saved, or else they hope to get, perhaps, a few shillings extra. Perhaps—for there is room now for any suspicion—they tried every publisher in town, from Burlington and Great Marlborough Streets to Finch Lane, or farther, if a "farther" there be, before they entered into treaty with the "Row." The advantage they have gained ought to be great, for great is the paltriness of having even thought of seeking for it. But though the odium of the "transaction" falls upon the Institute, I do not imagine it met with the concurrence of all or even a majority of the members. At least, I know one or two who look upon it in pretty much the same light as I do myself.

Dismissing this matter, I have to remark that, as far as the volume itself is concerned, there is very little in it indeed to identify it with the Institute, or which manifests any of that co-operation to be expected from a body established, it may be presumed, to effect what the zeal and study of individuals cannot pretend to accomplish. What we obtain from it is altogether the result of private study and individual diligence; and one of the most valuable papers in the "Transactions" is a contribution from one who is not a professional architect. Very far am I from complaining at meeting with papers of that class, the acceptance of which is rather creditable than otherwise to the Institute, because it shows liberality of feeling towards amateur students. What I complain of is, that there is nothing to show either what the Institute has done, or what has been done in architecture, during the time it has been established, and since the publication of the first portion of its Transactions. There are no official documents or records of any kind; no official report upon the chief of the very numerous buildings erected or undertaken during that interval, both in this country and upon the continent; no extracts from the correspondence of foreign members, nor any authentic information so derived; no notice of foreign publications presented to the Institute—I do not mean critical notices or reviews of them, but simple statements explaining their contents. Nay, there is not a single record of the briefest kind of any of the more eminent men in the profession who have died within the last five or six years, either British or foreign. Wilkins, Wyatville, Rickmann, Foulston, Albertolli, Antolini, Schinkel—some, if not all, members of the Institute, have within that period terminated their earthly labours; yet not one syllable of record has been bestowed upon their memories or their works, by the Institute whose "Transactions" are in that respect, and not in that respect alone, a complete blank. After this let us hear no more of the public indifference to architecture, when even the Royal Institute of British Architects shows itself to be infected with almost inexcusable apathy. The members and council of the Institute would do well to recollect, that though they themselves may choose to shut their eyes to what ought to be done by them for the advancement of architecture as a liberal study, they cannot hinder other people from opening theirs, and keeping awake to them and their proceedings.

I remain,

Yours, &c.

A GREATER ADMIRER OF ARCHITECTURE THAN OF THE INSTITUTE.

REMARKS ON THE CLAIMS OF ARCHITECTS.

SIR—The first two articles in the August No. of your Journal tempt me to make a few observations; for although the remarks therein are no doubt generally good and useful, they certainly do appear to me rather too sweeping and unqualified.

In the first article, the merits of the Threadneedle St. structure (and

I suppose its novelty is considered as not its least merit,) serves as a text for enlarging on the demerits of almost every thing in the way of architecture that has been done of late years, in the metropolis at least, and of underrating Grecian architecture in particular, as if *it* were responsible for all the abuses of mere builders, decorators, would-be architects, and, it cannot be denied, of some from whom, as architects of high standing, we might have expected better things; and I can only account for *their* failure by supposing them deficient in that natural taste and feeling for the art which is indispensable to a successful exercise of the profession.

I must, however, beg to differ entirely as to the facilities which "Stuart's Athens" in particular affords for producing Grecian designs, as I do not see how this publication can supersede or render unnecessary study and invention, more than publications in any other style; and I think it may be found that Mr. Barry himself, who deservedly stands pre-eminent as an architect, has *his* book of reference, too, and that the most prominent features of detail in his best designs might there be found delineated. It is not, then, the use of this or that style, this or that order, moulding, or ornament, which constitutes a good or bad design, but the spirit and mode in which they are applied and dealt with; and there can be no more good reason for rejecting any of the materials of design which former ages have produced, especially when of acknowledged beauty, than of shunning the letters of a language because they have been used over and over again, and for the commonest purposes. There clearly, then, must be materials to work with; but I think it cannot be doubted that to natural taste alone, which can neither be learnt nor unlearnt, is owing those superior productions in architecture, which so few can boast of the opportunity of displaying. To afford the facilities for embodying and bringing before others, those treasures of the mind which one individual possesses over another, a suitable education is, however, necessary; and 'tis impossible (I think) to conceive it can be carried to excess.

The orders of architecture, as found in Greece, (not Rome,) are indeed beautiful, but they will not bear being trifled with; he, therefore, displays most taste and judgment who, instead of endeavouring to drag them in on all occasions, rejects them altogether, unless he can place them in a situation befitting their high rank: for we can well perceive, by the ancient examples, how much sublimity and grandeur they are capable of producing, not, however, by the Italian method of first degrading them in detail, and then forming separate pieces of columnar design, for mere ornament, to doors or windows, as exemplified at the Travellers' and Reform Clubhouses, but by making them primary and useful parts of an edifice.

The remarks in the second article, headed "Spirit of Architecture," are, some of them, so extraordinary, that I am rather doubtful whether to treat them seriously or not. The London architects will, I am sure, have no reason to be proud of some of them, and if any, or even the majority, are deserving of them, 'tis hardly fair to include the whole; it would be much fairer to allude to the particular parties, or at least their respective works. There are architects, however, elsewhere than in London; and I think I could point out some examples of design in distant parts of England by native architects, that would induce even the severe author of "Spirit of Architecture" to pause in his denouncements, especially when contrasted almost side by side (as in some places they may be) with such productions of eminent London architects as alone can justify that author's severities.

I never before heard of architects altogether disregarding public opinion, when not expressed in such absurdities as whited towers and churches, roughcast sculpture, and reddened plaster fronts. Indeed, to show that discretion requires to be used in yielding to public opinion, I myself have heard one of that public (and one, too, who had travelled) seriously suggest as an improvement that a certain public building should be painted red, and scored in imitation of bricks; and yet the paper quoted seems to say that the *uncultured* mind is not only a more fitting judge of architecture, but would make a better architect than such as have spent a life in its study and exercise. Such remarks, however, are innocent enough, inasmuch as they overshoot the mark; but, for the same reason, they must fail of doing good, which should be the object of all criticism.

How an architect can be too architectural, or too strictly educated, I really cannot conceive; 'tis, I fear, far too likely, in most instances, that the fault is that of deficiency; although, as I said before, education can neither bestow nor take away that natural taste and talent which enables an architect to excel: and to these gifts of Nature was perhaps owing that eminence in their day of those interlopers, as they are called, Michael Angelo and Sir Christopher Wren; to neither of whom, however, are parties agreed now-a-days in attributing the highest excellence as architects. The praise, too, bestowed on the latter in the "Spirit of Architecture" stands in rather awkward juxtaposition with the observation in the former article, where, in alluding to the ugly churches of London, it does not except "the more *admired* than admirable ones by Sir Christopher Wren."

If architects' duties really are passing away from them to civil engineers and decorators, that surely must be the fault of the employer, not the employed; and it would be a slur indeed on public taste and discernment to imagine for a moment that, until they have searched Great Britain to every corner, they should have recourse to civil engineers or builders, the former being almost proverbially incapable of strictly architectural productions; while, on the contrary, architects, if educated as they ought to be, must be equal to all an engineer's duties, which they do and will perform, when prejudice does not prevent their being called on. From builders no one, I believe, ever expects anything like architecture; and those who do permit them to unite the offices of architect and builder too not only show themselves careless of the merits of the production as a work of art, but must find, too late, that they thereby deprive themselves of that salutary check on the builder, which it is part of the architect's office to afford. And as for *decorators*, my little experience teaches me that they have happily much less controul than formerly. The Reform Clubhouse is not the only nor the most decided instance on which I found this observation; and, depend upon it, it is almost invariably the employer's fault, either through ignorance or custom, if ever the decorator, or any other pretender, is allowed to interfere with any part of a building which has to do with its effect in the minutest particular. Much more might be said on these subjects, but I leave it to more able although not more zealous friends to architecture, and merely state, in conclusion, that, instead of issuing such sweeping denunciations, it would, I think, be a far more useful plan to bring forward, analyze, and compare the several examples of architecture separately, with a view to ascertain their merits and demerits, as such.

Aug. 11, 1842. AN ADMIRER OF ARCHITECTURE.

[We are at a loss to understand wherein lies the iniquity of contrasting the Threadneedle Street structure with other London buildings, and indeed we do not very well see by what means its relative merit could have been estimated, but for some such species of comparison. We have never held Grecian architecture answerable for the faults of those who occasionally misapply it, nor is it the use but the abuse of Stuart's Athens we have ventured to reprehend. Such works we admit may, perhaps, be perused as diligently by Mr. Barry and other men of merited celebrity as by the most notable imbecile of the confectionary faction; but we suspect that in the one case the designs are received merely as suggestions, in the other as the responses of an oracle; and it is scarcely necessary to remark, that it is the latter species of appropriation we have alone reprobated.

We pass over several of our correspondent's observations, and hasten to state that we have never maintained mental cultivation to be unfavourable or even unimportant to architectural proficiency, *provided the cultivation be of the right description*, but that there is a species of cultivation productive only of weeds, and fatal to every germ of genius, nature may have implanted. It is a familiar enough remark that wherever schools of art flourish, the arts themselves decline; and if it be the property of the prevailing system of architectural instruction to discourage the growth of the natural emotions and create others that are peculiar and artificial—to superinduce an irritability of taste respecting petty observances, and a disrelish of the ordinary beauties of ordinary minds—to quench all natural sensibility of heart, and impose upon the judgment by the authority of a senseless jargon—to eradicate nothing but taste, imagination, and genius, and foster nothing but mannerism, affectation, and formality; if this, and more than this, be the general tendency and general effect, too, of the existing modes of education—and all because they are too technical, stringent, and specific—it is easy to understand how the education of an architect may be too architectural and his taste less true than tastes less systematically perverted. Education can never create taste, but may ennoble or debase it according as the education is in a right or wrong direction; and the prevalent direction in the case of architecture is, we conceive, such as to be generally productive of unfavourable influences. From such influences the architects of ancient Greece were in a great measure exempt; they girded on their armour and went forth with their fellow citizens to the battle—they listened to the discourses of the philosophers, and mingled in the assemblies of the people, and shared in the anxieties of the commonwealth, and partook of the responsibilities of the administration; they felt not as architects merely but as men—their associations were not the associations of a sect or individual, but of the community, and their beauties derived not from Egypt nor Phœnicia but from Nature Had they, like us, been content to be servile copyists of exotic constructions or pedantic retailers of authoritative dogmas—had they, like us, assumed that another people had, by some happy intuition, found out the only forms in which beauty could be embodied, and that nothing was left for them but to multiply and combine those mysterious proportions—they would never have risen beyond the limits of mediocrity, and the world would have been deprived of the delight, and themselves of the glory, their more adventurous career has so bounteously conferred.

The insinuation that it is a distinction of the popular taste to entertain an affection for rough cast sculpture, is one of those inoperative libels which finds its refutation in its own extravagance; and as regards the other proofs of the depravity of the public predilections, it is sufficient to say that we think them singularly inconclusive. A whitened tower may be a very picturesque object in some situations, and if it be true that a brick wall may be less displeasing than an architectural abortion, the recommendation to imitate brick in a certain public edifice may, for aught we know, have been far from injudicious. It is rather a novel doctrine, we think, that if a man's business passes away, it is necessarily the fault of his employers, and never of himself; but however consolatory such a conviction may be, we fear it will be found to be a poor indemnity for so serious and substantial a deprivation. We agree with this gentleman in thinking that men excel in architecture by virtue of a "natural taste and talent," but are unable to reconcile this with the declaration that engineers and decorators are necessarily incapable of architectural productions. It is difficult to imagine that nature reserves her taste and talent for architects exclusively; and if a fair proportion be distributed among engineers and decorators, those of them to whom this qualification falls, ought, by our correspondent's own canon, to be perfectly capable of architectural excellence. We agree that the architect is a salutary check upon the builder, and the value of this check the public is well able to estimate. The praise and reprehension of Sir Christopher Wren may appear to stand awkwardly together in our pages, yet both may we conceive be perfectly just; and the awkwardness will we suspect appear most conspicuous to those who will not understand that an extensive edifice or multitude of edifices may afford matter for just ridicule and just commendation, and that the genius of an artist however great, may still be liable to some exceptions. It would have been quite foreign to the purpose of the spirit of architecture to have entered into the details of architectural composition, or compared one building with another, with a view to ascertain their merits and defects; and we think the title even of that paper is enough to show that its concern was not with the details and specialities of architecture, but with its radical and universal principles. Any remarks upon such a subject must necessarily be sweeping, simply because they are general; and we think it rather an extraordinary course to object to its strictures, not because they are unjust, but merely because they are not personal.—EDITOR.]

REVIEWS.

Transactions of the Royal Institute of British Architects. Vol. I. Part 2. London: Longman & Co., 1842.

(Concluded from page 260.)

THE paper by Herr Hallmann, of Hanover, on the Greco-Russian Ecclesiastical Architecture, is a valuable contribution. As an historical essay, and an exponent of manners and customs relative to the Greek church, it will be perused with interest by all classes of readers, while to the professional architect, it affords a new and instructive study on the great radical principle of his art—the adaptation of the arrangement and character of an edifice to the especial purpose for which it is destined. A comparison of the Greek and Romish ecclesiastical edifices, for which, as regards the former, this essay affords ample materials, cannot fail to impress strongly upon the mind of the British architect, that the study of combinations differing from both is demanded of him by the ritual of the Reformed Catholic Church of England. It is difficult to conceive any thing more repugnant to reason and sound taste, than the recurrence, in these days, to ecclesiastical arrangements peculiar to the worst form of superstition and priestcraft that ever degraded the Christian community; and yet such is the style of planning churches loudly called for by ignorance and intolerance at the present moment, and dignitaries of the establishment are not ashamed to prostitute the influence of their station by joining in the cry, under a Jesuitical pretence of encouraging architecture. But to return to our immediate subject. After a prefatory historical sketch of the progress of ecclesiastical architecture in Russia from the tenth century, Herr Hallmann proceeds to describe the plan, arrangement, and decoration of a Greco-Russian church. To follow this description connectedly would be to transcribe the bulk of the paper; we shall, therefore, be content to extract so much as relates to the principal feature of the interior—the Iconostasis, or screen separating the sanctuary from the body of the church. It is probable that many who may have had the opportunity of seeing Greek churches, may not be aware of all the mystical intention of their ornaments:

"A perfect Iconostasis is the *representation of the universe*, or rather of the *celestial kingdom*. It is composed of four or five different tiers, four of which are indispensable, as will be presently explained. Each tier is composed of an unequal number of pictures of saints, painted on tablets or long square surfaces, the position of which is rigorously fixed.

"On the first tier, which rises generally a few steps above the ground, (the number of steps is indifferent provided they do not exceed seven) are three doors; the middle is a folding door, by means of which a view of the altar is obtained during the ceremony, and is ornamented with the Annunciation of the Virgin, the Virgin on one of the leaves, and the angel on the other, accompanied by the heads or emblems of the four evangelists; on the right is the effigy of Christ, on the left that of the Madonna—on the right after that of Christ, is placed the picture of the saint or of the festival of the church—then come the smaller doors already mentioned, which are single doors. Above the central door there are occasionally three angels' heads, as symbolical of the Trinity; above the smaller doors are placed, on the left the Greek cross, on the right the cross of Moses, symbols of the new and old dispensations. Such are the indispensable arrangements of the first tier; if there be more room, it may be ornamented with other pictures of saints. Of these principal pictures only the heads, hands and feet are visible, the body is covered with a metallic clothing or drapery of silver or gold in very flat relief—the ground, like that of the whole Iconostasis and often of the entire church, is gilt. Before each picture a lamp is suspended exactly in the middle, and the pictures ought not to be higher than to allow of kissing at least the feet.

"On the second tier Christ is represented in the middle, seated on a throne, clad in pontifical robes. On the one side is St. John the Baptist, on the other the Madonna without the child—after that appear on each side two archangels and six apostles; the different tablets upon which these effigies are painted, seem in the ancient churches joined to one another without ornament—in the more modern they are divided by little gilt columns.

"On the third tier we find the Madonna in the middle seated on a throne, holding the infant Jesus on her knees; on each side of her are seen the effigies of the prophets.

"On the fourth tier God the Father is represented on his throne in the centre, with the infant Jesus—on each side are the patriarchs of the church; on this last tier the effigies are surmounted by small arches, the centre one being higher than the others. As the figures in the middle are seated, they are twice the size of the others which are standing. Sometimes there is a fifth tier, which is placed either between the first and second, or between the second and third; and upon the tablets of this tier are representations of the history of the Saviour, the last supper, the passion, the crucifixion, &c.; this tier is generally only half the height of the others.

"It remains yet to be mentioned that on the vault of the great cupola before the iconostasis is generally painted an enormous head of Christ, and that a great lustre nearly touching the iconostasis is suspended before it.

"The other parts of the church are ornamented with paintings on a gold ground; even the columns are decorated in this manner; but all these paintings represent miscellaneous subjects. In style they are wretched, and perfectly resemble the art of the early Christian ages. The church is lighted generally by very narrow windows, perforated in the side walls, or in the drums of the cupolas; for festivals there is a great display of lustres, made of plated copper, which hang from the vaulted roof. The general internal appearance of the Greek churches is on the whole extremely solemn and imposing on account of their magnificence and mystic aspect."

The Institute showed their sense of the merit of this paper at the time it was read, by presenting a silver medal to its author. The editors of the volume have done him less than justice as regards the illustration of his work. There are two general plans and one elevation, and six specimens of Russian cupolas, crammed into one quarto plate, and the plans especially are so small as to be nearly useless. A second plate represents an Iconostasis on a better scale.

The "Report of the Committee appointed to examine the Elgin Marbles" in order to ascertain whether any evidences remain as to the employment of colour in the decoration of the architecture or sculpture, will require little observation, since it was printed entire in the last No. of the Journal. It is in one sense a most satisfactory document, since it sets at rest for ever all question as to what traces of colour may or may not exist upon the marbles subjected to examination.

This report concludes the first portion of the volume, comprised under the general head of "Antiquities." The first paper of the second part, coming under the head of "Construction," contains some very important statistical facts on the cost of certain public buildings abroad, chiefly at Berlin, communicated by Herr Beuth, of that city, honorary and corresponding member of the Institute. Many of the buildings particularized are published in Schinkel's "Architectonische Entwuerfe," so that the proportionate expense of building in Prussia and England may be easily deduced from the information furnished by Herr Beuth. By a schedule of prices for labour and materials, it appears that the former may be obtained in Berlin for less than half its cost in London, measured brickwork for about two-thirds, and timber for little more than one-fourth. These rates must be kept in mind in estimating by the sums total the scale of liberality on which the modern public buildings of Prussia have been erected. It appears that the sum of £47,883 has been expended on the new church at Potsdam, £94,810 on the Theatre Royal at Berlin, £30,879 on the School of Royal Architects, &c.

Mr. Gwilt's "Observations on the Weight of Entablatures" refer to the proportions between the supports and the mass supported, in the orders of architecture; and he shows a probability that the proportions assigned by the ancients to their columns and entablatures, may be founded on a principle of making the area of the mass supported, taken on the geometrical elevation, equal to that of the supports, and the voids, or intercolumniations, equal to the amount of both. It is clear at first sight, that these conditions are fulfilled by any colonnade, where the intervals are systyle, and the entablature somewhat more than one fourth of the height of the column, proportions which are very nearly observed in the best works of antiquity. The rules laid down by Vitruvius tend to the same point, and Mr. Gwilt's position is further strengthened by the actual measurements of some of the ancient temples which he has compared in a table, though others are rather wide of the mark. It is impossible to suppose the coincidences which occur to be accidental, but they will scarcely bear out a general rule, which, to be worth any thing, ought to be of general application. The effect of such a law in architecture would be, to increase the load in proportion to the diminution of the support. It is obvious, that as the height of any series of supports of given diameter is increased, and their strength consequently diminished, both really and apparently, the intervals between them increase in area, and so therefore must the superincumbent mass be increased in order to fulfil the conditions. It is true that *within certain limits* this is the actual practice of the ancients. A Corinthian entablature one-fourth of the height of the column, is a greater proportionate load than a Tuscan entablature bearing the same relation to its support, (the intercolumniation remaining the same). This apparent anomaly has been very well explained by Sir W. Chambers, and we object to Mr. Gwilt's view of the subject, only because it is too sweeping, and because we think he ought to have taken the limits of the ancient practice into the account.

We do not understand the author's mode of dealing with the pediment. The diagrams on this subject require explanation; they seem to represent the entablature diminished in height until the addition of the pediment makes up the required mass; but we are not aware of the existence of any such practice either in ancient or modern composition. Nor can we discover by what process the voids in the portico of the Pantheon are made out to be equal to the solids, as stated in a postscript by Mr. Cresy, especially as these proportions are set down very accurately in the preceding page as 1·84 to 2·43. It must be observed that Mr. Gwilt does not by any means insist upon this part of the theory, but as regards the proportions between the supports and the weights, he considers that there is every appearance of its being strictly true.

The next paper in order is on "Lithology," or observations on stone used for building; by Mr. C. H. Smith. Mr. Smith, it is scarcely necessary to remind our readers, was a member of the Commission appointed to survey various quarries throughout the Kingdom, for the purpose of selecting stone for the new Houses of Parliament. The information resulting from this inquiry has found its way to the public in several shapes, but in none more likely to be of general practical utility than the able and well digested performance before us. The author treats principally of those extensive and useful classes of stone, the sandstones and the oolites; but we must rather call the attention of our readers to the pertinent remarks which occur on the consequences of want of attention on the part of the architect to the quality of the materials offered for his use. The effects of this negligence are particularly to be noted in the metropolis, where all stone must be brought from a distance, and where even the most inferior is scarce and dear. Mr. Smith shows that of Portland stone, so much in request in London, there are numerous shades of quality, dependent mainly on the position of the bed from which it is raised, and partly from the variation in the corresponding beds in different localities, and yet this circumstance is scarcely ever considered in selecting the material. Portland stone is Portland stone, and the architect is too ready to accept it as it comes to market.

> "I have carefully looked over," says Mr. Smith, "many specifications for public and private buildings, and find the materials usually described to be of the best quality; but the general tenour of those parts describing the stone to be used rarely amounts to anything more than the mere well-known name, preceded by an adjective, such as "*good* Portland stone," but what is to constitute that "*goodness*" is altogether undefined.
>
> "Large quantities of Portland stone of an inferior quality are brought to London, not because the island is deficient in the best kind, but because all our large buildings are executed by contracts, at so remarkably low a price, that the mason's study is not what kind of stone will be most durable, but what stone can be wrought by the workmen most expeditiously, and thereby yield the largest profit; and of course the proprietor of the quarries will only send such stone into the market as is likely to suit his customers. St. Paul's Cathedral, and many of the churches and other large buildings, erected in the reign of Queen Anne, were constructed with stone very superior, as far as regards durability, to the greater quantity now used; and yet the quarries from whence those sources were derived have been deserted beyond the memory of any inhabitants now living at Portland; and the only reason assigned is, because the merchants find they cannot sell such stone, on account of its being a little harder, and thereby more expensive to work."
>
> "Abundant examples of defective Portland stone might be pointed out; but when we consider that the stone brought from the island, good, bad, and indifferent, is all shipped from the same pier, which is a very small one, and that notwithstanding the blocks are marked in the quarry, so as to denote from whence they were obtained, it is possible that some of them may be misplaced, we ought not to be surprised if occasionally a very bad stone is conspicuously placed in a building that is otherwise in excellent condition; and this we find more particularly to be the case in our modern structures, arising no doubt sometimes from ignorance or inattention, but often from some trifling interest, such as using a stone because it is just of the dimensions required."
>
> "There are not fewer than fifty or sixty quarries already opened at the Isle of Portland, most of them along the north-east and north-west cliffs, at an elevation of several hundred feet above the sea. The stone from each of these quarries, and from different beds in the same quarry, almost always presents some minute particularities, which, on very attentive examination, will serve to distinguish it from others. In many instances these distinctions are so conspicuous as to be evident on the most casual inspection."

Bath stone is brought to the London market under precisely the same circumstances.

> "The principal quarries are at Box, Coombe Down, and Monckton Farleigh. The stone from each of these districts, and even in the same quarry, where there are generally a number of beds lying upon one another, is frequently found to differ, in some of the minor characters, from all the rest; such as being harder, coarser, more or less durable, &c., all of which are indiscriminately sold in the markets under the general name of "Bath stone," and it rarely happens that an architect specifies what kind of Bath stone is to be used. It is always understood that the materials are to be good, or of the best kind; and it unfortunately too often happens that the stone which looks best when fresh from the workman's hand, is frequently of a description most subject to premature decay. If it be left to the mason's choice, he is sure to select the stone that may be most expeditiously worked."

Bath stone finds little favour with our author, who disposes very satisfactorily of the common notion that it stands better in its native air than when exported to a distance.

> "The plain matter of fact is," says Mr. Smith in his plain matter-of-fact style, "that the stone used in the construction of the oldest buildings at Bath was procured from the Box quarries, which is in the more important qualities very superior to and far more durable than such as is now generally used. The Box quarry stone is still used occasionally in and about Bath, but the stone merchants in London have long since discovered that the masons will not buy it on account of its being a little coarser and harder, and thereby more expensive to work."

Two other vulgar errors on the same subject are also noticed. Speaking of the decay which is already manifest in the restorations of Henry VII.'s chapel, Mr. Smith observes as follows:

> "That there are many stones in the building which at present show no symptoms of decomposition is readily admitted; and those persons who advocate the use of Bath stone for such highly decorative purposes, frequently imagine that sufficient care has not been taken to place the stones on their natural bed. The importance of such precaution is generally very considerably overrated; I do not consider it signifies which way a stone is fixed, unless it presents a decidedly laminated structure, which scarcely ever occurs amongst the oolites. A stone of an open, powdery, and slightly cemented texture, will, if exposed to the weather, decompose in a comparatively short space of time, in whatever direction it may be fixed, or whichever surface may be parallel to the horizon.
>
> "Another generally received fallacy is the opinion that soft stone will become hard and durable by exposure. Although this notion is true to a certain extent, it is not of sufficient importance to warrant its appreciation in architectural works. All kinds of stone while in the rock, or when recently quarried, are somewhat softer and more easily worked than after they have been exposed to the atmosphere a few months, owing to the stone in its original situation being more thoroughly saturated with moisture that can ever be accomplished after it has been once allowed to get dry. This is a principle well known to masons, for it is a general practice amongst workmen to frequently wet a stone, especially if it be rather of a hard quality, during their operation of working it into mouldings or ornaments, to make it work, as they term it "more kindly." If the stone be remarkably soft, it is advisable not to let it dry too fast after it has been taken from the quarry.

for fear of its cracking, in consequence of the moisture being removed from the outside before the interior of the block can have had time to evaporate; hence, while the central part remains of its original size and extremely damp, the surface will dry, shrink, and thereby cause many invisible cracks, the effect of which will be conspicuous after a sharp frost.

"All free-working limestones and oolites become in some degree harder on their surface by exposure to weather. This arises from a very slight decomposition taking place, which will remove most of the softer particles, and leave the hardest and most durable to act as a protection to the remainder. In addition to which, the pores and interstices of the surface get filled with dust and dirt, washed in by rain assisted by powerful winds; all which circumstances help to secure the least protected grains from external violence. If the stone be naturally compact and durable, a surface of this description will materially assist its duration; but, on the other hand, such material as the Heddington stone, near Oxford, or the most perishable Bath stone, will in due time similarly attain a hard crust, which, from the general body of the stone being loose and powdery, is not sufficiently compact to hold on; water will soak in behind the crust, cause a swelling and disruption on the surface, which ultimately breaks. The crust thus opened gradually bends forward more and more, until finally the weight of the disintegrated portion causes it to fall off. In some instances, as in Bath stone, these defective places rarely exceed an inch or two of surface before the decomposed part falls off; whereas the crust of the buildings at Oxford is so remarkably tenacious that it peels off and hangs like rags, often as much as a foot superficial, before it entirely separates. Upon the whole, I do not consider it a recommendation to a soft stone to say that it gradually becomes harder on the surface."

We must take leave of this paper, from which we are tempted to continue our extracts to a greater length than might be advisable. It is illustrated by a map of the Island of Portland, and a section of the strata from which the stone is raised. It concludes with some observations on M. Brard's process for testing the qualities of building stone by disintegration, which Mr. Smith holds rather cheap, as not being supported by established physical truths, that is to say, by the effects observed to have taken place in the same kinds of stone by long exposure in old buildings—Barnack stone, for example, which remains generally in the highest state of preservation in Peterborough Cathedral, and other buildings in the neighbourhood of the quarries, disintegrates rapidly under the process, while others which stand high for durability under this test, are found to have suffered severely from the slow tooth of age.

To Mr. Fowler's paper "On warming and ventilating the long room of the Custom House, London, upon Dr. Arnott's principle," we have but little to say. The practical application of a familiar principle is precisely one of those subjects best calculated to occupy profitably the time and attention of an evening meeting, and had we experienced the pleasure of hearing this paper read on such an occasion, we could have complimented the honorary secretary very sincerely on his production. But for its place among the transactions it has probably been indebted to its illustrations, which exhibit the only specimen of original design with which the Institute have favoured us. The composition in the second plate being quite unconnected with the practical part of the subject, it is to be presumed, from the extraordinary distinction with which it is treated, that the Society are proud of it. We must confess we would rather the same breadth of copper had been bestowed upon Herr Hallmann; but this, as the upholsterers say, is a mere matter of taste, and we hint an opinion upon it with extreme diffidence.

The concluding paper is a report on the construction of the stone arch, (or, according to popular designation, "stone beam,") which exists between the western towers of Lincoln Cathedral, by Mr. Nicholson, accompanied by an engraving, made from very careful measurements. This arch, which is an object of curiosity from its extraordinary flatness and lightness, consists of 23 stones of unequal lengths. The width of the extrados is barely 1 ft. 9¾ in.; the thickness of the arch is uniform throughout, and is 11 in.; the span 27 ft. 11 in. between the apparent abutments, but as the walls on both sides have been cased since the arch was built, the original span is 30 ft. The arch having settled into a somewhat irregular shape, doubts have arisen as to the nature of the curve; but Mr. Nicholson's minute investigation decides it to be a pointed arch, drawn from two centres, the chord of the southern arc being 13 ft. 11·664 in., and its versed sine 2 15/16 in.; and the chord of the northern arc 14 ft. 0·234 in., and the versed sine 2⅜ in.

The object for which this singular structure was erected is a mystery, and Mr. Nicholson considers it in vain to offer any conjecture as to its purpose. Mr. Papworth, however, suggests in a postscript, that it might have been set up at the time when the vaulting of the nave was built, as a fixed point from whence levels and measurements might be taken.

We now conclude our lengthened notice of this volume, with an earnest hope that the Institute may speedily be in condition to lay before the public another, equally instructive, entertaining, and ornamental. We can bestow upon them, at parting, no better wish.

Appendix D *to the new edition of Tredgold on the Steam Engine and on Steam Navigation. On the Archimedean Screw, or Submarine Propeller.* By ELIJAH GALLOWAY, Civil Engineer. London: John Weale, 59, High Holborn. 1842.

THIS is a work which does Mr. Galloway great credit, and which, we venture to predict, will be received by engineers most favourably. The subject is itself one of great interest, and Mr. Galloway has treated it in a very perspicuous and business-like manner. He evidently understands what he talks about—has studied it deeply and well—and has the art, moreover, of stating what he knows in clear, concise, and not inelegant language. Our inquisitorial office would speedily become a sinecure, if we had none other than such books as this to deal with.

Mr. Galloway first gives us a short historical account of the Archimedean screw as a propeller, from which we extract the following passages:—

"In a work on the theory of the screw of Archimedes, published at Paris in 1768, by M. Paucton, the following passages occur:—

'The oar is an instrument by means of which we are enabled to move a vessel on the surface of the water. It is a long lever, terminated by a flat end, by the pressure of which upon the fluid an operation similar to the action of a wedge upon wood is produced. The *point d'appui* of this lever is the pin to which it is attached; the moving power is the rower; and the resistance is the fluid: which is, however, contrary to the opinion of some writers. I am surprised that no one has thought of changing the form of the common oar, it being evident that it is not perfection. In effect, besides that the action of the rower is not calculated to make the vessel advance equably, because the oars describe arcs of circles in their movement, the rower is obliged at least to employ a moiety of his time and strength to lift the oar out of the water, and carry it in advance. To remedy this inconvenience, it would be necessary to substitute for the ordinary oar an instrument the application of which would be if possible uniform and continuous; and this property will, I think, be found in perfection in the ptérophore (the Archimedean screw). We should be able to place two of them horizontally and parallel to the vessel's length, one on each side, or one only at the fore part. The ptérophore may be entirely immerged, or up to the axis only, as is desirable. The size of the ptérophore will depend on that of the vessel, and the curvature of the thread on the velocity with which it is proposed to row.'"

This is, perhaps, one of the earliest notices of the screw as an instrument of propulsion since the revival of learning, but it appears to have been in use among the Chinese for that purpose from time immemorial. Some of the schemes of propelling by means of a screw, which drew the public attention about thirty or forty years ago, were simply importations from China. Mr. Galloway quotes some certificates, with the view of showing that the screw had been introduced in some of our Government vessels as an auxiliary means of propulsion as early as 1802, and that the models of the plans then adopted were subsequently examined and approved of by Mr. David Napier—than whom there are few better judges in all such matters. He then recapitulates the statements of Marestier in his work on American steam navigation; the projects of Brown, the inventor of the gas vacuum absurdity; and the speculations of Tredgold, which are shown to be in many respects erroneous; after which he comes to the era created by the achievements of Mr. Smith, to whom, we conceive, any success this mode of propulsion has realized is mainly attributable. The structure and performance of the Archimedes are next minutely described: with these details many of our readers are already conversant; and those who are not so we must refer to Mr. Galloway's work, as no abstract would be useful, and no abridgment would be right. Of Ericcson's propeller, shown in Figs. 1 and 2, we think favourably; and Mr. Rennie's modification of the screw, represented in Fig. 3, is certainly very ingenious. Hunt's propeller is also ingenious, though in its present state attended with many obvious inconveniencies. Capt. Carpenter's plan is a crudity, and is scarce anything more than a reproduction of one of Shorter's worst projects.

On the mode of communicating motion from the engine to the screw, Mr. Galloway makes some very judicious observations. The instruments for modifying motion are toothed wheels, straps or ropes, and friction surfaces; and as the screw has to move at a much greater velocity than the engine, the adoption of one or other of these agents is indispensable. Toothed wheels are very noisy, occasion considerable loss of power from friction, and are very susceptible of injury; friction straps are liable to stretch and slip, especially when subjected to the influences of heat, salt water, and steam; and friction surfaces

Fig. 1.

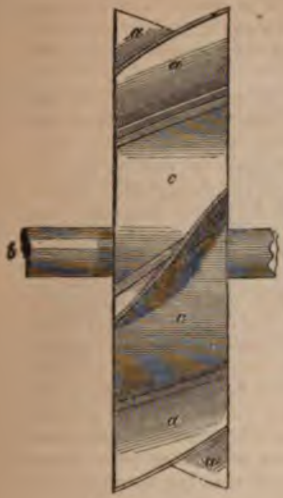


Fig. 2.

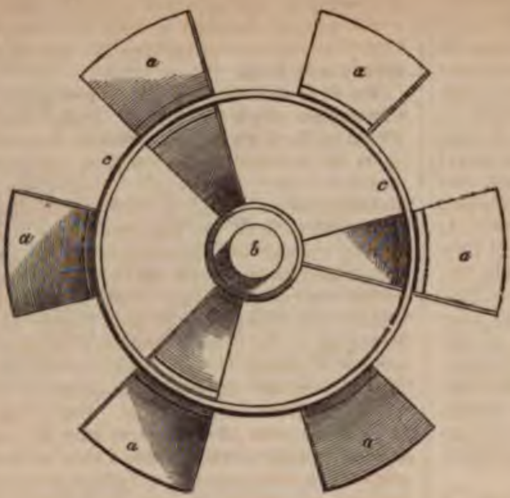
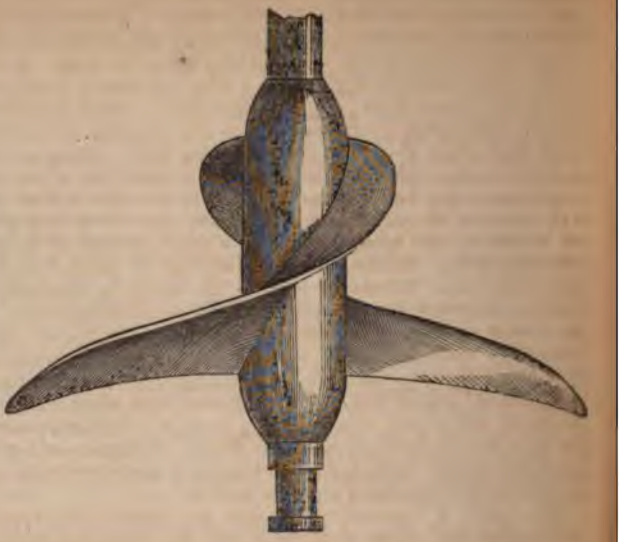


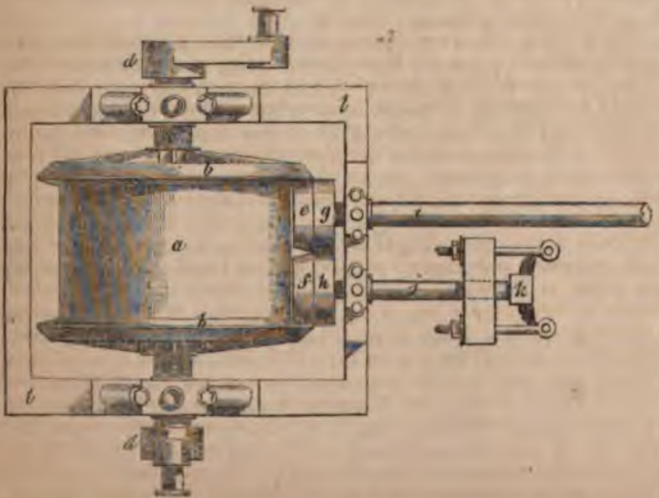
Fig. 4.



require a degree of pressure to attain the requisite adhesion, which invariably superinduces a most injurious friction in the bearings. With the view of obviating this defect of the plan of communicating motion by friction surfaces, Mr. Galloway submits the following contrivance of his own:—

"In this arrangement, shown at Fig. 4, it is proposed to use two engines of the form of which stationary engines are usually constructed, that is to say, they would have their beams above the cylinders and cranks: *d d* are the cranks, which are at a right angle to each other; *c c* the intermediate shaft; *b a b* is a double coned wheel connected by the cylindric part *a*. This is all cast in one piece, and accurately turned on the conical parts *b b*; *e g* and *f h* are two wheels attached to axes *i* and *j*. They are conical at the parts *f* and *e*, and cylindrical at the parts *g* and *h*. The diameters are one-fourth of the large cones *b b*. The axis *i* is the screw axis, and *j* the adjusting axis; *k* is a spring which, by means of screws, can be made to force the cone *f* towards the axis *c c*. If, therefore, we suppose a given force to be thus communicated, it will advance the surfaces of the cones together with four times the pressure there is exerted at *k*. In this condition of the parts, if the engines be put in motion they will cause the cones *b b* to turn the smaller wheels *e g*, *f h*, in opposite directions; but the pressure necessary to produce contact will be principally exerted between the cylinders *g* and *h*, which, being a rolling motion, is free from friction, and the power of the engine will thus be transmitted to the screw with only a loss of power entailed by the small amount of friction at *k*. It is obvious also in this contrivance that there is scarcely any friction at the bearings of *i* and *j*, which, owing to the cones having the force communicated at two opposite points in their periphery, exert no pressure on their bearings, except that of gravity."

Fig. 3.



We question whether this expedient, though a very good one, is the one wanted. A rotatory engine appears to be the desideratum, in those cases in which the screw requires to be driven at a great speed; and in other cases it is the best plan, we think, to employ engines of a short stroke, and couple them immediately to the shaft from which the screw derives its motion. This has been done in Mr. Wimshurst's vessel with very good effect, and, we believe, will invariably be found the best mode where the screw is employed merely as an auxiliary, or occasional impelling power. We find by a note, that Mr. Wimshurst's vessel, in which this plan is adopted, had not been constructed until after Mr. Galloway's book was written; to which circumstance we must attribute the omission of all notification respecting her. We therefore feel it right to say, as Mr. Galloway would, we have no doubt, have said, had the opportunity been afforded him, that Mr. Wimshurst's plan of driving the screw is the least exceptionable of any we have met with.

London as it is. By THOMAS SHOTTER BOYS. Folio. 1842.

MR. BOYS' "London as it is" is by no means London as it ought to be, or ought to be shown. It has, in truth, altogether disappointed us, for in no one respect is it at all satisfactory, the subjects being, with merely one or two exceptions, very badly selected, either quite stale, or otherwise of little interest, and very poorly represented, at least as views of buildings, for the architecture is very slovenly, loosely, and incorrectly drawn, and treated as altogether of subordinate interest in comparison with the figures. As far as buildings are concerned, quite as good or even better representations, and those, too, far less stale in point of subject, are to be met with in some of the penny and two-penny periodicals. There are, no doubt, many who will prefer Mr. Boys' bustling London street-scenes, with crowds of vehicles of every description, to far abler executed architectural subjects; but we question whether any of that class of persons are the purchasers of four-guinea books, unless they be those whom Sir Robert Peel terms the "vulgar rich."

The title of "London as it is" would naturally lead us to suppose that the work is intended to exhibit more especially the recent architecture and improved parts of the metropolis, by way of contrast to London as it was about thirty years ago. Yet if such was its author's purpose, he has adopted a most singular mode of following out such plan, there being comparatively few subjects which might not have been shown sixty years ago. Such buildings as Temple Bar, St. James's Palace, and the Tower—or rather its mere outside walls—have little to recommend them for selection; and the views are so limited as to number, that they ought to have been carefully chosen; nor do they possess novelty of any kind, having been represented before, over and over again, and in many instances very much better. Nay, as if it was so exceedingly interesting and beautiful a subject that it could not be too much studied, Mr. Boys has given *two* different views of Temple Bar; while of Newgate—which has so much of character and picturesque expression to recommend it to an architectural pencil—he shows nothing; of the Bank and its neighbourhood just as much; and of New London Bridge, and the new street and buildings just by it, ditto, not to mention other dittos—for that would be to make a list of almost everything worth showing. It is true, he does favour us with a sight of St. Paul's, but then it is only of a mere bit of it, as seen from Ludgate, where nearly all but the dome is concealed, and that is so drawn as to be so *unsightly*, that it might as well have been kept out of sight altogether. There is very little, indeed, to show what London is at the present day, where its street architecture has been improved. There is a view of Pall Mall, and two others of Regent Street, one of them taken from Hanover Chapel, of which not the front, but merely a single column of its portico is introduced, and that drawn monstrously out of proportion,—and they are almost all. Whatever may be his ability in other respects, Mr. Boys is evidently not a very able architectural draughtsman. In fact, he seems to have considered the buildings themselves as of very secondary importance—as nothing more than backgrounds to his groups of figures; and he would, therefore, have done better to have undertaken a work that did not require proficiency in architectural drawing, and whose title would not have held out the promise which, far as it is from fulfilling it, it now does. Foreigners, and others who have not visited London, must form not the most favourable idea of it from the representations here given of it.

The work is eminently calculated to dissatisfy and disappoint, if only by its challenging comparison with such works as Nash's "Mansions," Haghe's "Belgium," Müller's "Age of Francis I." &c., which it rivals in *price*, in size, and external appearance, but although intended so, is certainly not worthy of being placed on the same shelf with them. A similar remark applies to Morison's "Views of Haddon Hall," for though that also is *liveried* exactly like the publications we have just mentioned, it is so obviously inferior to them in execution that, even if admitted to the same table, it must be content to sit "below the salt." In truth, it is very ill-timed; had it appeared some half-dozen years ago, it might have been considered a very fair specimen of its kind, whereas now, coming after Nash's and other masterly specimens of architectural drawing and lithography, it manifests a very sad falling off. We are aware that the character we have here given, both of Mr. Boys' and of Mr. Morison's work, differs greatly from that expressed by other journals, who have spoken of both in terms of highest commendation—as they would probably do of anything else, no matter what—were it to come before them in the same imposing form and array. In fact, there are some journals which seem to keep *blank forms* of criticism, requiring merely to be filled up with the names of the publications sent to them, for the same tone, the same off-hand remarks, the same complimentary epithets occur again and again, and perhaps suit one work just as well as another.

On increasing the evaporative power of boilers, with incidental remarks on the management of furnaces and the prevention of smoke. By Charles Wye Williams, Esq.

Whatever we may think of Mr. Williams' talents, we must at least allow that his industry is most exemplary. To an ordinary man the duties of managing director of a steam company would alone have afforded abundant occupation; but so lightly do those duties sit upon Mr. Williams that he is able to reconcile them with the functions of an itinerant lecturer, and maintains as great an agitation respecting his patent projects as if no other subject had a claim upon his serious attention. We might applaud this diligence if exercised in a proper spirit or expended on a legitimate object; but when devoted to the multiplication of vain and arrogant elucidations of useless and puerile devices, its only effect is to quicken contempt and provocation into active resentment. But our anger if raised is immediately softened into commiseration by the spectacle of a man so possessed with the passion for popularity, even among withered hopes and in declining years, as to hold no means unsanctified that will place in his trembling hand the glittering gaud:—querulous and irritable from the conjunction of meagre abilities with measureless ambition—and growing old in dipping buckets into an empty cistern in the visionary idea that he draws something up.

We entered so fully into the merits of Mr. Williams' projects in some of our former numbers that it would be superflous now to re-examine them, especially as there is nothing in the present treatise capable of weakening in the least degree the force of our former arguments. We showed, we believe, to the satisfaction of our readers hat the spike boiler was neither original nor efficacious, and that the rgand furnace was neither more nor less than one of the old smoke burning projects raised from the dead, and disguised under a new name, and a few insignificant variations. The proofs of these facts it is needless to multiply, and would be useless to repeat; and we mean on the present occasion to limit our remarks to the characteristics of this gentleman as an author—his merits as an inventor being sufficiently notorious.

Mr. Williams commences by giving us an explanation of the circumstances which led him to inquire into the defects of boilers, and which he says "will be a sufficient answer to the assertion that engineers and boilermakers know their business much too well to lack instruction from a pack of effervescent chemists and druggists." These circumstances are, that in 1823 he established a steam company "and undertook to have the first steam vessel constructed capable of maintaining a commercial intercourse across the Irish channel during the *winter* months, and which till then had been considered impracticable," —that with respect to the perfection to which the *hulls* of steam vessels have been brought, he begs to refer to the specifications of those belonging to the City of Dublin Company furnished to the commissioners of steam vessels inquiry—and that with respect to the perfection to which both *hulls* and *machinery* have been brought, he refers us to the steam ship Oriental. Our readers will perhaps be puzzled to discover what all this has to do with the allegation that engineers and boilermakers are at least likely to know something more of engines and boilers than a parcel of empty and self-sufficient apothecaries; and indeed we are at a loss to discern any purpose in these intimations, unless it be to impress us adequately with Mr. Williams' importance. But we think the illustrations peculiarly unfortunate: the specifications referred to are very imperfect in many respects, and all the world knows that the most of the vessels belonging to the City of Dublin Company are the worst planned and most unsightly tubs afloat. The *Oriental* is certainly a fine vessel, though we are not aware of anything peculiar about her for which particular merit can be claimed: but nothing can be clearer than if the nature of Mr. Williams' responsibility be such, that to him is due the merit of success, to him should also be due the demerit of failure if failure arise. Now the Liverpool, the consort of the Oriental, and also under Mr. Williams' controul, *was* at first a failure; yet Mr. Williams declines all participation in the blame consequent thereupon: so that it would appear to be his happy prerogative to monopolize all the credit of success, and throw the odium of failure, as often as it occurs, upon some other person. Mr. Armstrong states in his treatise on steam boilers that the return of the Liverpool on her first voyage to New York arose from the introduction of some species of smoke burning scheme—or at least some tampering with the furnaces of which the makers of the machinery did not approve; and although Mr. Williams denies that this was the cause of the failure, he admits that such interference actually took place with the view, he says, of *relieving*, if it could not *remove*, certain supposed defects in the construction of the boiler. This admission settles the question: for if the boilers were taken out of the hands of the manufacturers, and the furnaces altered to suit the views of other parties, the manufacturers could not be held accountable for the result: and as the same boilers, so soon as the furnaces were restored to their original mode of action, enabled the vessel to make subsequent voyages to New York without any failure, it would certainly appear that the first failure arose not from any inherent defects in the boilers themselves, but in consequence of the introduction of some *improvement* which when removed or discontinued enabled the boilers to operate with their proper efficacy.

It had always been our impression that steam communication had been maintained across the Irish channel during winter antecedently to 1823; but Mr. Williams assures us that up to that date the maintenance of a commercial steam intercourse during winter was looked upon as impracticable. Now a commercial steam intercourse could hardly be held to be impracticable if any kind of steam intercourse had previously been maintained; for the doubt was not whether a bale of muslins could be carried, but whether the voyage could be performed under adverse circumstances of wind and water; and as this doubt continued to exist according to Mr. Williams up to 1823, when he first built a steamer, and showed it to be without foundation, we must set him down, as by his own showing, the first person who accomplished regular winter voyages across the Irish channel. Now in a report of a Select Committee of the House of Commons of the date of May 2nd, 1822, and another of the date of June 12th, 1822, we find it stated that a steam communication had been maintained all the preceding winter across the Irish channel, and that numerous steam vessels commercial and others had maintained a regular winter communication upon the open sea for some time previously. We confess ourselves unable to reconcile this statement with that of Mr. Williams, that up to 1823 when he began operations such an achievement was looked upon as impracticable; and we trust that our readers before they arrive at any conclusion, will weigh well the testimony on both sides of the question. On the one side they have the positive assertion of a gentleman of experience and station upon a matter personal to himself, and in which it is hard to suppose he could be mistaken. Upon the other side they have the declarations of a committee of the House of Commons, backed by the evidence of a host of witnesses who it cannot be supposed had any desire, even if they had the power, to falsify a matter which must have been abundantly notorious. Every reader must form a conclusion for himself from the balance of evidence before him, and will probably adopt that opinion which involves the least wonderful supposition.

The general character of the present work is identical with that of Mr. Williams' other literary productions:—intolerably prolix—marvellously superficial—and absurdly ostentatious: and indeed these are among the cardinal specialities of the minute philosophy and the natural concomitants of imbecile pretension. An author of this class never knows when to have done—he is unwilling to lose any opportunity of making the most of his talents and materials—and takes especial care that nothing of the least moment shall be dismissed till its merits have been made apparent to the most impenetrable or inattentive. In the idea that anything which has once suggested itself to him cannot be unimportant to the world in general he gives his readers —not a selection of his conceptions—but them all, and dilates and elaborates the most paltry truism to the consequence of an important proposition. He does not possess the forbearance to state his views and arguments in a popular and concise manner, and cast them upon the waters of public opinion to sink or swim as their merits determine; but must have long speculative introductions and learned mystifications—endless repetitions and digressions—illustrations and deductions—recapitulations of what every body knows, and demonstrations of things nobody ever thinks of doubting—objections anticipated and answered—and predictions as to the influence of his doctrines upon the fortunes of all men, and the destinies of all future generations; and if an idea of more than ordinary value is hit upon, it is exhibited in so many different lights and reproduced in so many different attitudes, that its whole force and elasticity are extinguished,—the reader is wearied, perplexed, disgusted,—and turns with aversion or pity from the perpetual display of such vain ambition and such conspicuous penury.

But we question whether the operose dullness of Mr. Williams' literary perpetrations constitutes their most exceptionable characteristic. There is a vein of disingenuousness running through them which often excites our shame and provocation, and their uniform tone of arrogance and pomposity cannot fail we fear to alienate every reader's affections, and give rise to associations not by any means favourable, and nearly, if not altogether indissoluble. Indeed this gentleman's arrogant and emphatic manner operating upon his habitual trick of overrating all his own conceptions, occasionally gives rise to the most ludicrous combinations. His revelations are preceded by such a note of preparation, and such precautions to ensure for them a distinguished reception, that the highest expectations are excited, and when after having prepared his hearers for something very impressive, he utters, as is often the case, only an *italicised* truism or inconceivable stupidity, the ridicule is irresistible, and its effect scarcely ever to be got over. Such a failure admits neither of toleration nor apology—it makes weakness manifest where a display of strength was intended—and must eventually be fatal to the faith of the most credulous even of his disciples.

We regret to find, that Mr. Williams has in the present work repeated the absurd charges he brought against our mechanical engineers on a former occasion, of being altogether ignorant of the chemistry of combustion, and of knowing nothing whatever about boilers. Our engineers have treated these charges with the significant silence to which, perhaps, they are alone entitled; but our function leaves us no such option, and we feel called upon to tell Mr. Williams articulately and in direct terms, that his charges are unfounded. If our leading engineers know nothing about engines or boilers, where is such knowledge to be found? Does Mr. Williams imagine that he or the most accomplished master of gasconade or falsetto will be set down as the depositary or originator of that mechanical proficiency which has made this country the envy and admiration of surrounding nations—added dignity to her sceptre, and magic to her name? Or shall we conclude that Mr. Field, Mr. Farey, Mr. Miller, Mr. Brown, and numerous others we could mention—men who would be ornaments to any profession, and on whom the mantle of Watt has descended—have spent a life-time of laborious study and experience in achieving no progress and acquiring no knowledge, and are up to the present moment ignorant even of those elements of chemistry with which every school boy is conversant? One of two things is clear: either Mr. Williams makes a statement he does not himself believe, or supposes that to be acquainted with any simple truth it is necessary to rave and fume, and vociferate respecting it. It appears never to have occurred to him that true science is a thing which shuns all display and noise, and that eminent merit is generally united with eminent modesty.

The Hand-book of Manchester. By B. LOVE. Manchester: Love and Barton.

THIS is a well-illustrated work. It contains a description, with views, of most of the public buildings of Manchester; likewise some interesting statistic information connected with its manufactures. It is a book that ought to be in the hands of every visitor to that important "Metropolis of Manufactures."

REPORT OF THE COMMISSIONERS ON THE FINE ARTS.

REPORT.

WE, the Commissioners appointed by your Majesty for the purpose of inquiring whether advantage might not be taken of the rebuilding of your Majesty's palace at Westminster, wherein your Majesty's Parliament is wont to assemble, for the purpose of promoting and encouraging the Fine Arts in your Majesty's United Kingdom, and in what manner an object of so much importance might be most effectually promoted, humbly report to your Majesty that we have taken into our consideration the matters referred to us, and have given due attention to the Report of the Committee of the House of Commons in 1841 on the Fine Arts, together with the opinions of various other competent persons on questions relating to the special objects for which the present Commission was appointed, and have consulted the architect as to the manner in which various kinds of internal decoration would affect his intended architectural arrangements; and we beg now to report our opinion that it would be expedient that advantage should be taken of the rebuilding of the Houses of Parliament for the purpose of promoting and encouraging the Fine Arts in the United Kingdom.

Having thus come to an opinion on the first point to which our inquiry was directed, we have, in conformity with the instructions contained in our Commission, proceeded to consider in what manner the above-mentioned purpose could best be accomplished. With this view we have, in the first place, directed our attention to the question whether it would be expedient that Fresco painting should be employed in the decoration of the New Houses of Parliament, but we have not yet been able to satisfy ourselves that the art of Fresco painting has hitherto been sufficiently cultivated in this country to justify us in at once recommending that it should be so employed. In order, however, to assist us in forming a judgment on this matter we propose that artists should be invited to enter into a competition in Cartoons, and we have prepared the draught of an announcement on this subject, offering premiums of public money, to which we request the sanction of your Majesty.

In framing this announcement we have felt that, although the competition which we at present wish to invite has reference chiefly to Fresco painting, yet if we were to confine our notice entirely to that method of painting, an inference might be drawn therefrom that we intended to recommend its exclusive adoption for the decoration of the new buildings. We have, therefore, inserted in our announcement paragraphs intended to explain that the future attention of the Commission will be directed to the best mode of selecting for employment artists skilled in oil painting and in sculpture, and that due consideration will be given to other methods and departments of Art applicable to decoration generally.

We humbly subjoin as an Appendix to this Report, some papers treating in detail various considerations connected with the subject of our inquiry.

Albert—Lyndhurst—Sutherland—Lansdowne—Lincoln—Aberdeen —J. Russell—F. Egerton—Palmerston—Melbourne—Colborne—

Charles Shaw Lefevre—Robert Peel—J. R. G. Graham—Robert Harry Inglis—Henry Gally Knight—B. Hawes, Jun.—Henry Hallam—S. Rogers—George Vivian—Thomas Wyse.

Gwydyr House, Whitehall,
April 22, 1842.

APPENDIX.

The general object of the Commission considered in relation to the state and prospects of the English School of Painting.

As the Commission is understood to take up the present inquiry where the Committee on the fine arts, appointed by the House of Commons in 1841, left it, it will be proper, by way of introduction, to recapitulate the leading opinions expressed in the Report of that Committee.

It was there observed that "the chief object aimed at by the appointment of the Committee," was "the encouragement of the fine arts of this country;" that it was "requisite that a plan should be determined upon, and that as soon as practicable, in order that the architect and the artist or artists to be employed, may work not only in conjunction with, but in aid of each other; that thus the abilities of both would be exerted for the decoration of so eminently national a building; and at the same time encouragement beyond the means of private patronage, would be afforded not only to the higher walks, but to all branches of art." The report proceeds to recommend the employment of fresco painting in the decoration of the new Houses of Parliament, suggesting, however, the necessity of further information and inquiry.

The appointment of the Commission has fully secured the latter, and the general objects of the Committee have been recognised in the notice respecting a competition, already prepared for publication under the sanction of Her Majesty's Commissioners.

It is here proposed to consider the question of the decoration of the Houses of Parliament with reference to the state and prospects of the English school of painting. And first it is to be observed that, although "all branches of art" may be entitled to the consideration of the Commission, historical painting is not only generally fittest for decoration on a large scale, but is precisely the class of painting which, more than any other, requires "encouragement beyond the means of private patronage." The want of such encouragement has long been regretted, not by professors only, but by all who have turned their attention to the state of painting in England;—a proof that the promotion of historic art is an object of interest with a considerable portion of the public.

The inference is not unimportant; for an already existing estimation of the higher aims of art, is in itself an earnest of their success. The desire which has been manifested for historical painting would not be entitled to attention if it could be traced to a passing influence, or to a disposition to imitate what had been achieved in other countries, since this could only lead to the adoption of superficial qualities, betraying, sooner or later, the absence of a vital impulse. Such attempts would be the more likely to be ineffectual, if a different style, however humble, really corresponding with the national taste, were at the same time cultivated with marked success. The history of art is not wanting in examples of schools and of periods, with regard to which it might be a question whether a sudden demand for historical painting would have been a boon to the artists or to the lovers of art. The Dutch school of the seventeenth century might be adduced as a case in point.

It may here be remarked that, even where the direction of national taste is favourable to the cultivation of historical painting, the peculiar difficulties of that branch of art must sometimes place it in unfavourable contrast with inferior departments more commonly practised, and in which a relative perfection is more commonly attained. The disadvantages resulting from this contrast are peculiar to modern times: at the revival of art and during its progress to excellence the efforts in the grander style were not in danger of being undervalued, or stimulated to injudicious rivalry, by such a comparison. No school exclusively devoted to indiscriminate imitation then existed. The present influence of such schools and examples may partly account for and excuse the occasional fastidiousness of modern amateurs with regard to efforts in historical painting, and may render a consistency of style more difficult for the historical artist.

These admissions with regard to the present difficulties of the highest style of art cannot, however, render it necessary to vindicate its abstract claims; the sole question for consideration now is, whether in this country and at this time there exist grounds for hoping that historical painting could be cultivated with success, and whether it would awaken a more general interest, if it were duly encouraged by the State.

That the actual estimation of this department of art has direct reference to the moral wants of our own nation, is further proved by the repeated exertions of individuals in proposing plans for the promotion of the higher style of art, by the generous encouragement occasionally extended to its votaries by others, but above all by the efforts of the artists themselves. For it must always be borne in mind that the aims of the artists are not to be considered as accidental predilections apart from the public feeling, but as representing a portion of that feeling. However variously modified by other influences, the formative arts must always express the manners, the general taste, and, to a certain extent, the intellectual habits of the nation in which they are cultivated; the chief conditions with regard to the last being, that the objects of mental interest should be analogous to the pursuits of taste, and at the same time familiar to that portion of the public to which the arts are addressed.

But to whatever extent the mind or manners of a nation may be communicable to its productions in art, the result is to be looked for rather in general tendencies than in degrees of technical excellence, and is especially to be sought where controlling influences, even of a salutary kind, are least likely to interfere with the free expression of national taste. Thus, the indications in question are not so evident in religious subjects, in which a common education, and long consecrated themes, have tended to elevate to a common standard the taste of the civilized world; nor are they so distinctly manifested even in certain subjects of local interest, such as the acts of illustrious individuals, and the commemoration of national events; themes which patriotism has everywhere supplied, and which presuppose a uniformly ennobling influence. The proper and peculiar tendency, the physiognomy, so to speak, of national taste, is to be detected in more spontaneous aims; in the direction which the arts have taken, when their course has been unrestrained, save by the ordinary influence of the intellectual and moral habits of society.

It might be interesting to trace the connexion between the arts and national culture and character under such conditions; but the general truth of the view above taken has been so often dwelt on by the historians of art, that it must be unnecessary to adduce examples of such a connexion where circumstances must render it more than commonly direct. If it were proposed to compare the English school of painting (as regards its general tendency) with the schools of other countries, it would, however, be just to consider the direction of taste in the latter when art has not been employed in the service of religion and patriotism, for it is under these circumstances that painting has been cultivated in England. The result of such a comparison would tend to vindicate the aim and character of the English school.

But the inference from the above statement, which is more immediately applicable to the present question, is, that the efforts of the English artists in the higher branches of their profession are to be regarded as an evidence of the tendency of taste in a considerable portion of the public, and it remains to observe that both the efforts and the taste may be almost irrespective of the common relation between demand and supply, since the due encouragement of the higher branches of art may be "beyond the means of private patronage." This apparent contradiction of a moral demand, for a particular class of art, existing independently, in a great measure, of its usual consequences—the actual employment of those who, with due encouragement, might respond to it, is explained by the fact that the decoration of public buildings, with a view to moral or religious purposes, has always been necessary for the formation of a school of historical painting. The history of arts shows that whatever may be the extent of general education, the service of religion or the protection of the state is indispensable, at the outset at least, for the full practical development of the highest style of painting. Thus formed and thus exercised historic art lives and is progressive, but with the aid, however liberal, of private patronage alone, either its aim becomes lowered, or its worthier efforts are not sufficiently numerous to re-act on the general taste.

To many it may appear unnecessary to assert the capacity of the painters or of the public for the cultivation or appreciation of elevated art. But it must be remembered that while the great stimulus and support of public employment is wanting, the exertions of the artists are gradually compelled into other directions; and some observers, looking at this result alone, may draw erroneous inferences from it,—may sometimes hastily conclude that pictures of familiar subjects, which have been of late years predominant and deservedly attractive, represent the universal and unalterable taste of the nation.

Such observers might, however, at the same time remark that the productions in question oftener approach the dignity of history than the vulgarity of the lowest order of subjects, and either by the choice of incidents, or by their treatment, still attest the character of the national taste. The evidence of an intellectual aim in familiar subjects, may be therefore considered as an additional proof that the artists of England want only the opportunities which those of other nations have enjoyed, in order to distinguish themselves in the worthiest undertakings. But to place this question in its proper light, it will be necessary to take into consideration the peculiar circumstances under which the English school has been formed.

The great impediments to the cultivation of the higher branches of art have been already adverted to. With few exceptions, painting in England has not been admitted into churches, (a subject which it is not intended here to discuss) nor has it been employed to any extent in the embellishment of public buildings. Other difficulties have existed, owing to various accidental circumstances.

The perfection which the great Italian masters arrived at, was the result, it is true, of slow experience, but happily for them the more ornamental and fascinating qualities of the art were attained last. With the English school it was the reverse. Its rise in the last century was remarkable for sudden excellence in colouring and chiaroscuro, an excellence so great, as to eclipse contemporary efforts in a severer style, while it gave a bias to the school. The peculiar union of what are called the ornamental parts of the art, with those essential to history, which has prevailed in England, not unattended with some sacrifice of more solid qualities, has been generally attributed to this influence.

This mixed character became more decided in consequence of the circumstances under which the school was developed; namely, the subsequent introduction and prevalence of a style suited to small dimensions. Most of the distinguished English artists in the time of Reynolds painted the size of life. The experiment, as regards private patronage, seems to have been then fairly made, and the gradual change to reduced dimensions, appears to have been the consequence of the insufficient demand for large works, arising in a great degree from the limited size of English dwelling-houses.

Hence the execution of small historical pictures; a practice recommended by the occasional example of the best masters of every school. But where the subject is dignified, smallness of dimensions cannot consistently be accompanied by smallness of treatment. Minute imitation is not found in Corregio's Gethsemane, nor in Raphael's Vision of Ezekiel, diminutive as they are. The breadth of manner which is indispensable in such elevated themes is not, however, essential in familiar subjects, and hence, when specimens of both styles, similar in size, but widely different in their technical conditions, are placed together, the impression produced by so marked a contrast is unsatisfactory, without reference to the difference of subject.

Thus, partly through the influence of the "ornamental" character of the school, and partly to prevent this abrupt contrast of treatment in pictures which are to hang together in galleries, (for under such circumstances, the more abstract style appears to disadvantage,) the kind of historic art chiefly followed, is that which admits picturesque materials, thus combining the attractions of familiar subjects, with the dignity of the historic style. Under such influences has been formed an interesting portion of the more modern English school, distinguished on the one hand from the Dutch, and on the other, from the small works of the Italian masters, embracing a great variety of subjects, sometimes scarcely removed from the familiar, sometimes approaching the grandest aim.

The circumstances that have led to the general adoption of a small size are thus it appears, accidental, and the actual practice of our painters cannot be adduced as a proof of their original choice of such conditions. The frequent efforts on their part, amid various difficulties, to recommend larger dimensions, are a sufficient proof of the real inclination of the artists. These efforts have not been confined to the ardour of youthful inexperience; many of our best artists have returned to, or persevered in such undertakings to the last; with some, the ambition to encounter the difficulties of this style was first kindled at an advanced period of their career. In the last century all the principal English artists, notwithstanding Hogarth's success in small pictures, were in the habit, as already observed, of painting the size of life—Reynolds (considered as an historical painter), West, Barry, Fuseli, Copley, Northcote, Opie, and others.

It cannot therefore be admitted that the artists of England are, by their own choice, confined to small dimensions; but the questions now are—

Whether it is possible to afford more favourable opportunities than those which have hitherto existed for the adequate display of historic art?

Whether such opportunities will be sufficiently numerous? for if not, the school, after attaining the excellence which honourable employment will assuredly call forth, may again languish; and, lastly,

Whether such encouragement will be in danger of diverting the taste and practice of some artists from that domestic art which is now so successfully cultivated?

The first of these questions, while it is immediately connected with the special object of the Commission, involves the consideration of the abstract relation of dimensions to styles of art. This subject has been often discussed on grounds independent of technical requisites, and as very different opinions have been the result, it may here be allowable, without undervaluing the conclusions derived from other considerations, to refer to the mere physical or external conditions which must necessarily affect the question.

In comparing the treatment of cabinet pictures with that of works of the largest size—for example, where the figures are colossal—it may be observed that the small picture, besides being executed with delicacy, generally exhibits a certain fulness of detail, while the large work is not only less elaborate, but is composed of fewer parts. Even assuming the same subject, and one requiring a variety of minute accessories, to be represented on a colossal and on a small scale, it may be safely affirmed that the degree of detail which would be admissible in the small picture would be objectionable in the larger. In a grander and more ideal subject, where such detail would be inadmissible under any circumstances, the comparison could be less fairly made, but a similar influence would be more or less apparent. Thus, assuming other conditions to be common, the greater space never allows the introduction of *more* detail than the smaller, but generally, if not always, requires *less*.

Without entering into the examination of this question as connected with the laws of vision, it may be remarked that although the indistinctness arising from distance may be counteracted, as regards the most important qualities in art, by increased dimensions, and by appropriate style and treatment, it must still tend to exclude certain refinements of imitation which are appreciable in pictures requiring to be seen near—refinements capable of conferring an interest on details that may be unimportant in themselves. The inference is at once applicable to the question proposed. The familiar subject, as fullest of accidental circumstance, must be best displayed in dimensions fitted for near inspection, and, in an advanced state of art as regards imitative excellence, must be a consequence of the habitual adoption of such dimensions. On the other hand, the larger the figures in a picture, the greater the distance at which the work must be seen; and as the omission of detail is a consequence of that reduced scale of gradation which distance supposes—as the absence of minute particulars is felt to be the attribute of distance without reference to the size of objects, so the accessories in the larger work of art require to be few and important. Thus, again, increased dimensions, by involving the suppression of detail, suggest subjects of corresponding dignity.

Such appears to be the relation of dimensions to style and subject, considered with reference to technical results; as regards the question of taste, it may be observed that the involuntary conclusions derived from the influence of association agree with the practice of art. The analogy between grandeur and the absence of detail, and between minute circumstance and familiar incidents, is sufficiently apparent. With these analogies, the impressions produced by magnitude and its attributes, and by the opposite qualities, respectively correspond.

The general relation thus defined has often been reversed in works of art, but not with equally good results, for it may be remarked that large works, when elaborate in detail, and full of accidental circumstance, have the unpleasing effect of magnified cabinet pictures; on the other hand, diminutive historical works, when treated with that breadth which belongs to the grandest style, must give the impression of large works diminished. The last-mentioned inconsistency can hardly be objected to; grandeur of conception and treatment must unquestionably be acceptable in any form, but nevertheless the abstract breadth of imitation which is indispensable in elevated subjects is, under the circumstances supposed, a kind of contradiction, inasmuch as the vague generalization of a distant or ideal effect is submitted to close inspection, and can only be so viewed. The small pictures by Raphael and Coreggio, before referred to, are of this description; but the instances of such subjects being treated on so minute a scale are not frequent.

It is unnecessary to enumerate other exceptions, or to refer to larger works in which a just adaptation of style may have tended to obviate an incongruity between subject and dimensions. It may be sufficient to have dwelt on those plainer principles which result from the technical and external conditions that have been considered, but which may afford a criterion with regard to some of the more arbitrary conventions of works of art.

It may be added that even the extreme conclusions which might be deduced from the conditions referred to, are strictly conformable to the authority of the grandest examples of art. The loftier aim of imitation thus defined, may seldom be literally compatible with the usual range of subjects; but in this instance, again, the criterion, as such, may be admissible. Thus, assuming the representation to be dilated to its full measure, details of costume, illusion, and even the more delicate varieties of colour are no longer fitted for the dimensions. But in proportion as the subordinate excellences of imitation are excluded by the nature of the existing technical conditions, the display of the nobler qualities still attainable becomes more necessary. As the resources of art become more circumscribed, the artist's aim becomes elevated. In the highest style of painting, as in sculpture, the representation of inanimate substances ceases to be satisfactory when they no longer directly assist impressions of beauty or grandeur: and the styles of art in which the living form can be least dispensed with, are precisely those which, by the abstract character of their imitation, render it least objectionable.

The foregoing considerations may warrant the conclusion that the grandest style of art is best displayed in large dimensions. It will also follow that the treatment of subjects fitted for such dimensions, must tend to ennoble the style and taste of the artist.

Works of such magnitude, cannot be often in demand for ordinary dwelling-houses: hence, while pictures are excluded from churches, the places in which it is possible and desirable to employ the higher branches of art will be the national and municipal public buildings; all localities, in a word, where painting can be displayed to the public in its highest and most didactic form.

But will such opportunities and means of encouragement be sufficiently numerous and enduring? The answer to this important question can be best anticipated by the exertions of the artists; it may be reasonably expected that the employment of native talent in a great national building, will serve as an example throughout the country, and that the style of art which will be thus recommended and promoted, may be even adopted in fit situations for the decoration of the mansions and villas of affluent individuals.

In answer to the third question proposed, namely, whether the encouragement of historical painting, may tend to alter the direction of the taste and practice of those artists pursuing a hitherto more thriving and popular branch af art? it may be allowable to observe that even such a danger would be no just argument against the employment of deserving candidates for fame in another department. But the long neglected interests of the historical painters, can, it is believed, be promoted without interfering in any degree with the prosperity of the class in question. That school is already formed; and the cause to which it chiefly owed its rise,—the possibility of its productions being placed in apartments of ordinary dimensions, must ensure its duration; added to which, the societies for the encouragement of art by subscription and lottery, have solely in view the acquisition and distribution of comparatively small pictures. The object now is to find opportunities as fit, (they cannot possibly be as numerous,) for the development and display of historical painting on a large scale. Whatever may be the influence of the proposed encouragement on the rising generation of artists, it is at all events desirable that inclination should be free; that the inheritors of that enthusiasm which prompted the best English artists of the last century, to offer to decorate St. Paul's Cathedral and other buildings at their own expense, may no longer ask in vain even for space.

The general tendency of the national talent, has been hitherto considered in a great measure apart from the question of the actual qualification of the artists. It may be sufficient, in reference to this part of the subject, to acknowledge that the difficulties of the style of art which is now proposed, may be peculiarly great in England, owing to the circumstances before adverted to, and that no common energy may be necessary to surmount such difficulties. But while the artists are expected to show themselves worthy of entering on that career which is now opening to them, it is but just to remind the enlightened judges of art who refer to the great works of other countries, that those works were the result of repeated essays, and that considerable time was necessary for the formation of the taste and practice of those who produced them. In justice to the artists, the trial should be as fairly made in England.

On ordinary occasions the imitative arts may be considered as adventitious embellishments, but in proposing to adorn an important national edifice where it is essential that a characteristic unity of design should be maintained throughout, painting should appear as the auxiliary of architecture. It was thus that it was employed in the best ages of Greece and Italy, and it was thus that its highest development was ensured. In the present instance the chief decorations in painting will be required to be on an extensive scale. The difficulty of keeping large masses of canvas well stretched during all changes of weather. has been considered an objection to the employment of that material under such circumstances. The evil here alluded to may be seen in its worst form, in the ceiling of the chapel at Whitehall, owing to the surface of the paintings being highly varnished. The fittest kinds of painting, for the decoration of architecture, are those which can be applied, when required, to every surface, curved as well as plain, and for such general decoration, fresco—recommended as it is by the example of the great masters—appears to be better adapted than any other method.

The objections to the employment of fresco in London, on account of the smoke, have not been overlooked, and various information respecting the mode of cleaning such paintings has been collected. The opinions of Director Cornelius on the subject will be found in his statements. Professor Hess, on being consulted on this point,[*] remarked that "if frescos were painted in the open air in London, the rain would be the best picture cleaner." The observation is so far important, that it assumes the possibility of washing frescos freely without injury to the colours. Mr. Thomas Barker, of Bath, who painted a fresco of considerable extent in that city some years since, writes;[†]—"To clean fresco from smoke, I know of no mode so simple and efficacious as washing the surface with pure water, using a soft sponge in the operation." Mr. Barker elsewhere observes:—"it is now seventeen years since the completion of that work;" (the fresco he painted)—"if any change has taken place, it is in the colouring having become much more effective than when first completed." Mr. Andrew Wilson writes from Genoa[‡] that frescos there are cleaned with vinegar, so as to look as fresh as when first painted. Carlo Maratti used wine in washing the Vatican frescos, and succeeded in restoring the principal paintings notwithstanding the injuries and neglect of nearly two centuries.[§] There seems, therefore, to be no reasonable ground of apprehension on this account. With regard to the effect of the English climate, no very accurate conclusions can be arrived at, as the examples of older frescos in this country are not numerous. About the middle of the last century some frescos were executed at West Wycombe Park, by Guiseppe Borgnis, a Milanese, under the auspices of Francis Lord Le Despenser. The paintings are exposed to the open air, yet those in the east portico and south colonnade and loggia, are in general remarkably well preserved. The paintings in the west portico, from whatever cause, have suffered considerably. The east portico is an agreeable example of the union of fresco-painting with architecture; in the soffit is a copy of Guido's Aurora. Some ceilings in the interior appear to be painted in oil.

As long as any doubt is expressed as to the mode in which the antique paintings which have been preserved were executed,[‖] it may not be allowed to quote those works as examples of the durability of fresco painting in particular; but they afford strong evidence of the durability of painting on well prepared walls. Sufficient examples, however, of frescos, properly so called, that have stood for many centuries, exist in Italy. Among them may be mentioned: at Padua the works of Avanzo, though injured in lately removing the whitewash with which they were covered; in Florence those of Benozzo Gozzoli in the Palazzo Ricardi, of Angelico da Fiesole, Masaccio, and others; in Perugia those of Perugino; in Assisi those of Giotti, (the vows of St. Francis);[¶] these works belong to the 14th and 15th centuries. In S. Giacomo, Spello, Orvieto, Pisa, Siena, and Rome, various examples by the earlier masters are in good preservation, when unhurt by violence. The works of Luini, at Saronno and Lugano, may be mentioned as remarkable instances of frescos in perfect preservation after three centuries.[**] It has been supposed that the sea air at Venice may have affected the few frescos painted in that city; but in Genoa, where the influence of the sea air is more immediate, and the effect of storms more severely felt, frescos have lasted on the external walls of houses for some centuries.[††]

The practice of fresco painting, as far as description can explain it, is sufficiently detailed in the papers of the Appendix which follow, but it may be desirable briefly to examine its general qualities as a means of representation.

Its difficulties are not to be dissembled; they are, however, not the difficulties of the mere method, but arise from the necessity of an especial attention to those qualities which rank highest in art; qualities which, when not absolutely indispensable, are too often neglected. Defects in composition, form, action, expression, and the treatment of drapery may be redeemed in an oil painting by various merits; not so in a fresco. A style of art thus circumscribed cannot, therefore, be recommended for exclusive adoption; but if studied together with oil painting, its influence can hardly fail to be beneficial. The great Italian masters, as is well known, practised both methods; hence their employment, frequent as it was, in fresco, led to no imperfection, but on the contrary, may be considered to have been mainly conducive to the vigorous character of Italian design.

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[*] By Mr. William Thomas.

[†] February 10, 1842.

[‡] February 28, 1842.

[§] Memoir in the second edition of Bellori's Life of C. Maratti.

[‖] According to Sir Humphrey Davy's experiments, the antique painting called the Aldobrandini Marriage was unquestionably executed in *fresco*; no colours were found in it but such as stand in fresco, and the white pigment was lime. Other paintings appear, from his description of the materials, to have been executed in *tempera*, though he calls them fresco: but no wax (used in the *encaustic* method) was found in any of the specimens examined by this great chemist in Rome. (See The Philosophical Transactions, 1815, p. 97). In Pompeii specimens of encaustic are said to be frequent.

[¶] Letter from Professor Ernst Deger of Düsseldorf, 4th March, 1842.

[**] Communication from Mr. Ludwig Gruner.

[††] Letter from Mr. Andrew Wilson, Genoa, 28th February, 1842.

The immediate and necessary connexion of this mode of painting with the highest aims of art, fits it to embody those inventions which belong essentially to the domain of thought. As a mode of decoration for public buildings it has peculiar recommendations: no style of painting is more clear, distinct, and effective at a distance. This is partly to be referred to the thorough execution, founded on the intelligence of form, which it requires, and to the brilliancy of the material employed for the lights. But there are other causes of this distinctness of effect more directly connected with general design. With dimensions and distance, and a treatment that depends rather on power of light than on intensity or quantity of shade for its effect, a style arises which develops the elements of composition in some measure distinct from chiaro-scuro. The influence of these conditions is apparent in the best Italian frescos, which, at the same time that they exhibit the happiest adaptation of perspective and foreshortening, and often the most skilful management of gradations of light, are remarkable for impressive clearness of arrangement.

This style of composition is still more apparent in the celebrated cartoons of Raphael, in which it is carried to the most emphatic simplicity, still combining the picturesque principle of depth, as opposed to the flatness of basso-relievo. These works were evidently treated with reference to the material in which they were to be ultimately executed, namely, tapestry; in that material, as wrought in Raphael's time, powerful effects of light and shade were unattainable—a defect attempted to be remedied by heightening the relief of some of the objects with gold. The figures are, however, colossal in size, as the works were to be seen at a considerable distance, and the great artist attained distinctness by means of composition almost alone. The principal figures are rendered important chiefly by the place they occupy, and the story is comprehended at the first glance; thus a skilful arrangement supplies the absence of those modes of relief which might be resorted to in oil-painting; indeed the effect of light and shade, making every allowance for the injuries of time, is far weaker than that attainable in fresco.

But assuming this general style of composition to be applicable to fresco, it cannot be objected that, owing to its peculiar fitness in the case referred to, it would in any degree disqualify the artist for the practice of composition in oil-painting; for the cartoons of Raphael have always been considered to be among the most perfect examples of arrangement and of masterly clearness in telling a story, without any reference to the particular conditions which may have influenced the painter.

In like manner as regards colouring, the practice of fresco has never been found to have any unfavourable influence on that of oil painting, but rather the reverse. Without referring to particular works as instances of the perfection in both methods which the Italian masters of different schools—Francia and Raphael, Andrea del Sarto and Guido, Guercino and Pordenone[*] attained, it may be sufficient to mention the example of Corregio—in the opinion of Reynolds[†] the most consummate of painters as regards colour and execution. This great artist painted more in fresco than in oil, looking to the quantity of surface covered. In his case it is evident that even the comparative absence of depth and mass of shade in fresco had no unfavourable influence on his practice as an oil painter; while the clearness of his colouring in his oil paintings may not unreasonably be attributed in some degree to his experience in the other method.[‡] And here it may be allowable to express the opinion, that the great skill of the English artists in water colours might be the means of introducing new technical merits and a new perfection in the practice of colouring in fresco, which might again directly benefit the school of oil painters.

The foregoing are among the considerations which, it is considered, might induce her Majesty's Commissioners to recommend the promotion and encouragement of historical painting in connection with the rebuilding of the Houses of Parliament, while a hope may be here expressed that the example will be followed on other occasions. The employment of fresco, for a portion at least of the intended works might be proposed conditionally, since it must necessarily depend on the evidence of inclination and qualification on the part of the artists, to work in that method.

C. L. EASTLAKE, *Secretary*.

STATEMENTS OF DIRECTOR PETER VON CORNELIUS,

Relating to the Proposed Decoration of the Houses of Parliament.

THE following statements contain the substance of some opinions expressed by Director Cornelius on the proposed decoration of the Houses of Parliament. The particulars relating to the practice of fresco painting are extracts only from more copious details freely communicated by him. For some few allusions to facts, in the history of the arts, connected with the subjects discussed, the Secretary of the Commission is responsible. These additions are distinguished by brackets, or are given as notes.

The Situation.—Cornelius, the distinguished artist who has executed so many works in fresco at Munich and elsewhere, inspected the plans for the new Houses of Parliament, as well as the site of the buildings, during his short stay in London in November, 1841. His attention was first directed to the general situation, with reference to works in fresco. He thinks the situation unobjectionable. He has no idea that the damp of the river can have any effect on fresco paintings in rooms elevated as those in question will be above the actual level of the water. The effects of damp in the atmosphere are not apprehended by the German painters. Many failures that might have been hastily attributed to damp, were really owing, Cornelius observes, to the use of lime in too fresh a state. Of the experimental works painted at Munich in the open air those only have faded which are known to have been done without due attention to the materials. Thus, a figure of Bavaria painted by Kaulbach, which has faded considerably, is known to have been executed with lime that was fresh. Similar failures in less exposed situations have been traced to the same cause. The cupola of Val de Grace at Paris, painted in the 17th century by Mignard, faded soon after it was done, though sufficiently elevated above damp exhalations, because the lime used was too new.

The damp which, in the opinion of Cornelius, is really prejudicial to fresco, is that which is occasioned by the use of unseasoned materials—new timber, imperfectly burnt bricks, &c. The nitre which is so destructive to fresco he supposes to originate from the stones of the wall rather than from the mortar. Such causes of decay might exist in high and dry situations from want of care. But Cornelius lays the greatest stress on the necessity of using lime that has been long kept, since this comes in immediate contact with the colours, and is a colour itself.[*] When this eminent artist, in conjunction with others, painted the house of the Chevalier Bartholdy, in Rome, an old mason who had been employed under Mengs (a not unskilful fresco painter,) directed their attention to this point, and it so happened that they were then supplied with lime which had been preserved twelve years. The works alluded to, though the first executed by the modern German fresco painters, have stood perfectly well.

Among other precautions it is desirable to let the building itself dry well before painting the walls: yet Cornelius painted in the Glyptothek at Munich, not long after it was finished, from a confidence in the soundness and dryness of the materials. He however took the precaution to use water that had been boiled in moistening the surface and in thinning the lime.

The Style of the Architecture.—With respect to the question whether it is possible to preserve a due congruity between the modern taste in painting and Gothic architecture, the opinion of Cornelius is unhesitating; but this opinion, it will appear, is the result of particular views respecting the standard of pictorial excellence. He thinks the Italian works which the Germans most approve, and modern German art itself perfectly fit for such a purpose. The works of Heinrich Hess in the Allerheiligen Kapelle at Munich are, he observes, in one sense, a case in point, since that chapel is in the Byzantine style of architecture, the date of which is still earlier than the so-called Gothic. In these frescos the space round the figures is often gilt, and thus the rude splendour of a remote period is united with a grandeur of design derived from the purest examples of Italian art.

It is well known that in the middle ages the cathedrals and churches throughout Europe, however varying in their style of architecture, were more or less decorated with painted and gilded ornaments and scriptural or legendary subjects. [Vestiges of paintings, even in churches where stained glass had been used, are often found concealed under whitewash, and every year brings some to light in our own country.][†] Similar works in a ruined state have lately been discovered in the choir of the cathedral at Cologne. These are now to be replaced, Cornelius states, by Professor Steinle, and the general style to be adopted will correspond with the architecture. although the forms and draperies will be treated with a due regard to the best examples of art.

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[*] For a description of Pordenone's principal fresco, the cupola of S. Rocco at Venice, see Boschini, La Carta del Navegar Pittoresco, Ven. 1660, pp. 90—94.

[†] Notes on Du Fresnoy, Note LV.

[‡] The works of Corregio in fresco are here referred to merely to show that the practice of that method has no disadvantageous influence on the practice of oil painting; but the cupolas of Corregio at Parma are by no means favourable examples of the durability of fresco. Their decay appears, however, to have been owing to the former dilapidated state of the roofs and the penetration of damp, as the lower figures are better preserved. The fresco in the tribune of S. Giovanni was destroyed in enlarging that part of the church; part of the principal group, the Coronation of the Virgin, was fortunately saved, and was inserted in the wall of the library at Parma. It is in perfect preservation, and is one of the noblest works of the master.

[*] As the opinion respecting the necessity of using lime that has been long kept is frequently repeated in this paper, it may be necessary to state that other German and Italian fresco painters do not consider it essential to keep the lime longer than ten or twelve months.—See the remaining papers in the Appendix.

[†] Preston, Dartford, Rochester, the Chapter-house Westminster, &c.

Cornelius thinks that Westminster Hall might be decorated on the same principles, with a like attention to the character of the architecture. He considers that as the walls of such buildings were sometimes hung with tapestries, they could be quite as consistently adorned with paintings. It is to be observed that in the Hall of Constantine in the Vatican, painted by Giulio Romano and others from Raphael's designs, the edges of the frescos are made to imitate the appearance of tapestry; this treatment is also observable in some of the ceiling paintings of the Vatican, though differently contrived according to their situation. But Cornelius thinks no such approximation to the effect of hangings necessary, since paintings were quite as common as tapestry in ancient Gothic edifices. He considers the questions as to the appropriate style of sculpture and painting for Gothic buildings to rest precisely on the same grounds. and assumes that the artists of the thirteenth century would have added better ornaments to the architecture of the period if they had possessed the skill. He considers it nevertheless essential that a certain congruity and harmony should be preserved, less dependent on association than on general principles. He thinks that the style of some Florentine masters of the fifteenth century would harmonize well with Gothic structures of an earlier date or character.

It is here to be observed that the question of the adaptation of the style of art to the architecture is connected in the mind of Cornelius with that of the general expediency of returning to those severer principles of design which, it is acknowledged, first led to excellence in Italian art. With these views he connects the consideration of the nature and capabilities of fresco, as a means of ensuring attention to the elements of form and composition. The founders of the present German school, as is well known, at first proposed these principles and methods not as an end, but as a means which it was hoped would again lead to important results. But the attempt, according to the eminent artist so often quoted, was at the outset universally condemned. When a few individuals (with that artist himself, Overbeck and Veit at their head) began the revolution which they have now rendered comparatively popular, they had to encounter the most violent opposition and the keenest ridicule from their own countrymen; and even when, after years of perseverance, they had succeeded in gaining some favour at home, it was long before foreigners acknowledged their merit. Cornelius dwells on these circumstances in recommending the style above alluded to.

There are other considerations connected with the application of painting to Gothic architecture particularly, on which Cornelius was consulted, and which may not be undeserving of attention. The available spaces for painting in Gothic buildings are supposed to be unfavourable; the pointed arch, sometimes introduced superficially on walls, and the acute forms produced by the simplest groinings in ceilings are, it is remarked, difficult to fill satisfactorily. It is here necessary to bear in mind that the taste for this style of architecture declined in Italy much earlier than in the rest of Europe, and hence the examples of celebrated paintings in Gothic churches are rare; the works of Cimabue and other early Italian masters as Assisi, and those ascribed to Giotto in the church of the Incoronata at Naples are, however, cases in point, and had Gothic architecture continued to prevail in Italy, higher examples, it may be assumed, would not have been wanting. Cornelius does not admit that there is any unusual difficulty in adapting painting to the compartments of Gothic architecture. [It may be readily granted that all ceiling painting is difficult to contrive and execute, but no Gothic roof, assuming the groining to be simple, could present such difficulties as Michael Angelo had to contend with, in the angles of the Sistine chapel (the architecture of which is not Gothic), where the figures are painted on a projecting ridge formed by the meeting of two curves. The celebrated foreshortened figure of Haman is painted on such a surface. A portion of the ceiling in one of the Stanze of the Vatican, presents similar difficulties.] The more florid style of Gothic may be acknowledged to be unfit for pictorial decoration on a large scale; its surfaces being so crowded with ornamental panelling that little space remains for pictures.

Another objection to the application of painting to Gothic architecture. is the use of stained glass. A decoration so suitable in many instances to Gothic windows, is incompatible with the due effect of paintings on the walls, the colours of which require to be displayed by a colourless, and at the same time a sufficient light. This objection is met by the consideration that stained glass is not desirable nor usual in all Gothic buildings, to the extent to which it was employed in those of a sacred character. Its application elsewhere was generally less profuse, and might be so contrived as not materially to interfere with the quantity or quality of the light. In answer to a question on this subject addressed to Cornelius by letter, he replies: "The church 'in der Aue,' at Munich, which has painted windows, is not adorned with frescos, but the church of St. Francis, at Assisi, shows how painted windows and frescos may be combined. The paintings discovered in the cathedral at Cologne were without doubt executed immediately after the completion of the choir."[*]

Fresco as compared with Oil Painting.—Cornelius is decidedly of opinion that fresco should be preferred to oil painting for the decoration of the new Houses of Parliament. In pronouncing this opinion he is of course not alive to any of the considerations which would weigh with English judges respecting the present ignorance of the process of fresco in this country, and the comparative mastery of our oil painters. In no circumstances probably would he prefer oil pictures to fresco, in which he has for many years been constantly engaged, and in which his taste has been formed. He, however, supports his preference (at least with regard to certain applications of painting) by argument and example. He maintains that fresco is on every account fittest for monumental, permanent works in public buildings in which painting is to be considered as the handmaid of architecture. The Italian masters, he observes, were always fully impressed with the necessity of adapting their works to the effect of the architecture, so as to make one harmonious whole. The nature of fresco fits it for such a purpose. It is indeed impossible to produce that illusion which is considered so desirable in oil pictures—the same depth of shade is not in the artist's power; but this very circumstance, while it compels attention to composition, colour, and form, renders fresco more directly appropriate for strictly decorative purposes.

On no point is Cornelius more decided, than on the necessity of placing a given series of frescos under the controul of one directing artist. This appears to be quite compatible with the employment of many such directors, by subdividing the works; but he thinks it most desirable that in one complete series there should be a congruity of style and general execution. In Munich, where great experience has now been gained in these undertakings, several independent masters have formed scholars to work in their style, and these have been ultimately employed on original works. This gradual education of scholars is observable. if we follow the career of Cornelius himself. For example. when employed in his first work in Munich (the frescos of the Glyptothek) the cartoons were all the work of his own hand; the assistance he received was only in the execution of the paintings. In the Pinakothek his sketches and small drawings sufficed for his pupils to prepare some of the cartoons, and lastly in the Ludwig-Kirche the invention even of some subjects was entrusted to a scholar, named Hermann.[*]

No new modes of cleaning fresco have been devised in Germany. To a question on this point addressed to Cornelius by letter, he replies:—"The London smoke may, undoubtedly, have a disadvantageous effect on frescos; but with a due warmth—for example, by the introduction of warm air or warm water in tubes—I am of opinion that, in the situation where the new buildings are, no particular evil effects are to be apprehended. If, however, after fifty or a hundred years it should be found that the dirt had accumulated to a great extent, the surface could be cleaned with bread. The mouldy appearance which sometimes shows itself is to be removed with a wet sponge. The mouldy efflorescence which appears in some cases may be owing to saltpetre in the walls: for this there is no remedy; but, on the other hand, it never appears when the walls are built with well-seasoned and dry materials. In the Munich frescos no saltpetre has shown itself." [An artist of Rome, Cavaliere Agricola, has been lately employed to clean the old frescos in that city; he has published the result of his experience, and his report, which has been procured, would be among the documents to be referred to in any future inquiry relating to the modes of cleaning fresco. The method adopted by Carlo Maratti, in 1702, as I have elsewhere remarked, is also preserved.]

Time necessary for the execution of works in Fresco.—The whole scheme and invention of a series of frescos should not only be settled, but all the large drawings made by the time the building is ready; for the work can then advance rapidly. Supposing the present buildings to be ready in seven years from this time, Cornelius says it is time to begin the designs. The German artists, expert as they are in drawing, always take some years to prepare their cartoons. Cornelius's cartoon for the altar-wall of the Ludwig-Kirche at Munich was executed in Rome: he went there for the purpose. If Westminster Hall, or any other building already in existence, is to be adorned with frescos, the wall should be prepared with the first rough coat of mortar at once; for this ought to be on the wall, if possible, for some years before it receives the final preparation immediately before painting, unless very old lime be used in the first instance: but even in that case, six or twelve months should elapse before painting on it, to give it ample time to harden.

The practice of Fresco painting.—The Cartoon.—It may be assumed that it is impossible to retouch a fresco painting to any extent. The portion of the work undertaken in the morning must be completed during the day. The partial remedies and contrivances in case of unavoidable delay or accidental defects will be hereafter considered.

Hence every part of the design must be defined in preparatory studies: the fresco is, in fact, a copy from these, the forms being *traced* on the wall from drawings the full size. [Cartoons of the kind prepared for fresco (that is, without colours) may be seen in the National Gallery; namely, those at the head of the staircase, by Agostino Caracci.[†]] When the painting is to be very large, and it is found inconvenient to prepare a cartoon of the same size, the drawing may be made half the size: or, the whole composition of the full size may be divided into two or more cartoons: [thus Raphael's cartoon for the school of Athens, preserved in the Ambrosian Library at Milan, contains the figures only, without the architecture.] It is scarcely necessary to observe that the cartoon itself is, in the first instance, generally enlarged from small drawings of the whole composition, with the aid of careful studies for the separate parts. The following is the mode in which Cornelius prepares and fixes his cartoons. A strong cloth is stretched on a frame as if to be prepared for painting; paper is then firmly glued on the cloth. When this first layer of paper is quite dry, a second layer is carefully glued over it in the same manner. The edges of the separate sheets are a little scraped, where they overlap, in order to preserve an even surface. The surface is then prepared for drawing with size and alum. The drawing is made with charcoal, and, when finished, is *fixed* by wetting the back (the cloth) with cold water and then *steaming* the drawing in front. The effect of this last operation is to melt the size a little, thus fixing the charcoal.

A finished drawing of the full size being thus ready, the outline is *traced* from it on oiled (transparent) paper: if the finished drawing is half the size, it is enlarged by squares to the full dimensions, portion by portion: in this case the paper on which it is copied should be moderately thin, for the convenience of tracing on the wall. A part of this "working" outline (as much as can be finished in one painting) is now nailed to the wet wall, and the forms are again traced with a sharp point, which makes an indented outline through the paper on the soft plaster. The "working" drawing is generally destroyed in this operation. [The following is another mode: the paper to be applied to the wall is placed behind, and in close contact with, the finished cartoon; the outlines of the latter are then pricked, and the operation necessarily leaves a similarly pricked outline on the paper behind. The next process is to pounce the pricked outline of the latter, when fastened to the wall, with a little bag of black or red dust: this leaves a dotted outline on the wall. This method is sometimes adopted for small works, as the surface of the plaster thus remains undisturbed.] The first mode—tracing on oiled paper and then again from it to the wall—is, however, generally preferred, since it ensures the best and most decided outline, while the finished cartoon may be preserved uninjured. In many celebrated Italian frescos the indented outline, produced by tracing, is apparent.[*]

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[*] Without reference to the style of the architecture, the highest authority for the union of stained glass, to a certain extent, with paintings on the walls, is that of the Stanze of the Vatican, the windows of which were enriched with figures of angels supporting the papal arms (those of Julius II., and Leo X.), by the glass painter, William of Marseilles, at the very time when Raphael was painting the frescos of the same rooms. See Vasari, Vita di Guglielmo da Marcilla.

[*] The public spirit of the German artists is apparent in the circumstance of Cornelius himself now undertaking to superintend the execution of Schinkel's designs in Berlin, with scarcely any addition of his own. His own first original work in that city is to be the decoration of a Campo Santo.

[†] Presented by Lord Francis Egerton. Agostino Caracci assisted in the frescos of the Farnese Palace, and the two subjects in question were, it appears, designed and executed entirely him. See Lanzi, v. 5, p. 74, and Malvasia, v. 1, p. 439.]

It has been already observed that the fresco is a final operation; any considerable alterations that may suggest themselves when the cartoon is completed must be made on the cartoon, or rather on additional pieces of paper fitted upon it.

[One of the most interesting examples of the nature and extent of the alterations that may be introduced in a composition prepared for fresco, is the cartoon, already referred to, of Raphael's School of Athens. The changes are mostly additions. The figure of Epictetus, represented in the fresco sitting in the foreground on the left, leaning his head on his hand, is wanting in the cartoon. This figure was added to fill up a vacant space, and thus the change, though a considerable improvement, involved no inconvenience. Some less important alterations in the same fresco, such as covering the head of Aspasia with drapery instead of showing her flowing tresses (for thus she appears in the cartoon), might have been made on the wall without any change in the drawing. That this cartoon was the identical one which served for the execution of the fresco is proved by the exact conformity of every part, except the additions above mentioned, with the painting.]

Beside the Cartoon, in which the forms and general light and shade are determined, it is desirable to have a coloured sketch of the whole composition, for it is almost as impossible to change colours as forms after the fresco is done. In general, the German painters are not in the habit of making complete coloured sketches for this purpose.

The Preparation of the Wall.—If the wall to be painted is covered with old mortar, the ingredients of which are unknown, this coat should be entirely removed till the solid materials are laid bare. The rough coat then applied is composed of river sand and lime. The proportions of the sand to the lime may vary in different climates, and the working builder and mason are sufficiently experienced on this point. In Italy, it appears that two parts of sand were added to one of lime; the Germans generally use more sand, viz., three parts to one of lime. The thickness of the coat is such as is generally used in preparing the walls of dwelling-houses. The surface of this first application should be rough, but not unequally so; and the mason should avoid leaving cavities in it.

The wall thus prepared should be suffered to harden perfectly; the longer it remains in this state the safer it will be, especially if the lime used was in the first instance fresh. In that case, two or three years even should elapse before any subsequent operations are undertaken. Among the essential conditions of fresco painting must be mentioned the preparation and seasoning of the lime. At Munich it is made and kept as follows:—A pit is filled with clean, burnt limestones, which, on being slaked, are stirred continually till the substance is reduced to an impalpable consistence.[*] The surface having settled to a level, clean river sand is spread it over to the depth of a foot or more, so as to exclude the air, and lastly the whole is covered with earth. The German painters suffer the lime to remain thus for at least three years before it is used either for the purposes of painting (for lime is the white pigment) or for coating the walls. Cornelius prepared the lime for the Ludwig-Kirche eight years before he painted there. A great quantity is generally kept in Munich, and might, perhaps, be had from thence for works in this country. The late Lord Monson intended to have had lime from Munich for the works which Cornelius was to have done for him at Gatton. The pits or vats in which the lime is preserved are not lined with brick nor protected in any way; they are dug in the mere earth. The lime thus kept is found moist, as at first, after many years. Cornelius said that there might perhaps be no objection to lining the pits, so as to keep the lime clean, but that the usual mode was to slake it and keep it in the mode described.[†]

The ultimate preparation for painting on the dry, hard, well-seasoned mortar is as follows:—The surface is wetted again and again, with water that has been boiled, or with rain water, till it ceases to absorb. Then a thin coat of plaster is spread over that portion only which is to be painted; the surface of this coat should be but very moderately rough. As soon as it begins to *set* (in ten minutes or so according to the season), a second thin coat is laid on somewhat fatter, that is, with more lime and less sand,—about equal proportions. Both these layers together are scarcely a quarter of an inch thick. The plaster is laid on and the surfaces are smoothed with a wooden trowel—this at least is Cornelius's practice. Some painters like the last surface (which is to receive the fresco) to be perfectly smooth; one of the modes of rendering it slightly rough is to fasten some beaver nap to the trowel: another is to pass over the plaster in all directions lightly with a dry brush.

The process of Painting.—A portion of the outline is now traced with a sharp point on the plaster as before described, and the painter begins to work when the surface is in such a state that it will barely receive the impression of the finger, and not so wet as to be in danger of being stirred up by the brush: besides other inconveniences this would fill the brush with sand. If the wall has been previously well wetted, the plaster will not dry too rapidly; but if, during the course of a dry summer's day the, surface begins to harden too much and no longer takes the colour well, the painter takes a mouthful of water from time to time and sprinkles it over the surface, in the same manner as sculptors sometimes wet their clay models. Much evidently depends on the thorough wetting of the dry mortar, before the last preparatory coats are applied.

In painting, it will be found that the tints first applied sink in and look faint, and it is necessary to go over the surface repeatedly before the full effect appears. But after some time, especially if the surface be not occasionally moistened, the superadded colour will not unite with what is underneath. The change in some of the colours from the wet to the dry state can be best learned by experience, but it is usual to try the tints at first on a brick or tile that absorbs moisture.

After having completed the portion allotted to the day, any plaster which extends beyond the finished part is to be removed, and in cutting it away care must be taken never to make a division in the middle of a mass of flesh, or of an unbroken light, but always where drapery, or some object, of its own outline forms a boundary; for, if this be not attended to, it is almost impossible, in continuing the work the next day, to match the tints so that the junction shall be imperceptible; but by making these junctions correspond with the outlines of the composition, the patchwork which is unavoidable is successfully concealed.

In the next day's operation the surface of the old mortar is to be wetted as before, and care must be taken to wet the angles round the edge of the portion previously painted. This requires to be done delicately with a brush, in order to secure the sufficient moistening of every minutest corner, and also to avoid wetting or soiling the surface of the finished portion. On this last account it is better to begin from the upper part of the wall; for, if the lower part is first finished, the water constantly runs over the fresh painting.

When the painter is unable to finish a portion at once, or is compelled to leave it during the day for a considerable time, the Munich artists have a contrivance which arrests the drying of the work. A board is padded on one side, the cushion being covered with waxed cloth; a wet piece of fine linen is then spread over the fresh plaster and painting, and pressed to the surface of the wall by the cushioned side of the board, while the other side is buttressed firmly by a pole from the ground.

When any defect in the first operation is irretrievable, the spoiled portion is carefully cut out and the process above described is renewed for that particular part. The same remedy is possible in reviewing the finished work, but here again care should be taken that the portion cut out should be bounded by definite lines, for the reason before given. This attention to the nice adjustment of the successive portions of the work, so as to make one whole in the mere execution, is of great importance in fresco painting.

In the finished fresco the depth of shadows is often increased, parts are rounded, subdued and softened, by hatching, in lines of the colour required, with a brush not too wet; the medium then used being vinegar and white of egg. Shade is more easily added in this way than light, but some use crayons made of pounded egg-shells to heighten the lights. It is to be observed, that such retouchings are useless in frescos painted in the open air, because the rain washes them away, whilst the rain does not affect frescos painted without retouchings; of this the paintings on the Isar-Thor at Munich are a sufficient proof. [Cavaliere Agricola who, as before observed, has lately published a report on the Roman frescos, is of opinion that they were retouched with coloured crayons.[*] Vasari,[†] however, distinctly says that frescos which were not retouched were least subject to alteration and decay.] Various methods of this kind have, nevertheless, been resorted to by the Munich painters, and Cornelius has mentioned some

The Colours and Implements.—These details, communicated with all-sufficient precision by Cornelius, need not be inserted here, as they are given in other papers that follow. The colours are chiefly simple earths; no vegetable, and few mineral, preparations can be used with safety, but there is a mode of rendering vermilion durable. The palette is of tin, with a rim round it to prevent the colours, which are thinned with water, from running off. The colours, mixed or ground in water, are kept at hand in small pots. The brushes are of the usual materials, but they should all be somewhat longer in the hair than those used for oil-painting.

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[*] The outlines of Raphael's cartoons are covered with pin-holes. This is very apparent also in the fragment of the cartoon for the Murder of the Innocents now in the National Gallery. Of the cartoons above mentioned, by Agostino Caracci, one (the Triumph of Galatea) has the pricked outline; the other (the Cephalus and Aurora) not.

[†] The Italian mode, described in another paper of the Appendix is somewhat different.

[‡] Professor Hess directs the lime to be kept in pits lined with brick.

[†] Introducione, c. 19, and Vita di Antonio Veneziano.

(To be continued.)

MARTIN'S PATENT CEMENT.

Upon visiting the Sun Fire Office now erecting under the superintendence and from the designs of Mr. Cockerell, we were much gratified by the superior execution of the internal ornaments, which so far as the unfinished state of the building would allow us to inspect them, and leaving design out of the question, were singularly neat and perfect. Indeed we have scarcely ever seen mouldings present so finished an appearance. The great objection to panelled walls has hitherto been the very heavy expense consequent upon the employment of such mode of embellishment. The mouldings are run and the walls covered with a cement called Martin's Patent Cement, and present a surface nearly as smooth and hard as glass; it is applied in much the same way as any other cement.

TABLE OF PROPORTIONS OF THE PARTS OF CLYDE MARINE STEAM ENGINES—CYLINDERS.

All the figures which are not represented as feet or numbers are inches.

Names of vessels	BRITISH QUEEN.	DEE and SOLWAY.	DON JUAN.	HECLA and HECATE.	DEVONSHIRE & CAMBRIDGE.	BRUGES.
	—	—	—	—	—	—
Makers' names	Girdwood & Co.	Scott, Sinclair & Co.	Girdwood & Co.	Scott, Sinclair & Co.	Girdwood & Co.	Caird & Co.
Diameter of cylinder	76	73	68	60	55¼	51 11/16
Length of stroke	7 ft. 0	7 ft. 0	6 ft. 0	5 ft. 9	5 ft. 0	
Cylinder made with belt?	yes	no	yes	no	yes	no
Thickness of metal of belt	1¼	none	1⅛	none	1⅛	none
Number of steam openings into	2	none	2	none	2	none
Diameter of openings	flat for the reception of two slide valves	none	1 ft. 2	none	12½	none
Diameter over flange		none	1 ft. 11	none	1 ft. 9	none
Thickness of flange		none	1⅜	none	1½	none
Number of bolts in flange		none	8	none	6	none
Diameter of bolts		none	1⅛	none	1⅛	none
Thickness of metal of cylinder	1⅜	1⅞	1⅛	1⅛	barely 1⅛	1 5/16
Thickness of upper flange for cover	1⅜	1⅜	1¼	1⅛	1⅛	1¼
Breadth of flange	5	3⅜	3¾	3	3¼	3⅞
Number of beads or rings on cylinder	3	5	1	3	1	3
Depth of rings	2⅜	3	3	3	2⅛	3
Projection of rings	½	½	⅛	⅜	⅜	⅜
Bottom of cylinder cast in?	no	no	yes	yes	yes	no
Thickness of bottom	1⅜	1½	1⅛	1½	1⅛	1 5/16
Number of feathers on bottom	6		8	1 circle	8	6
Thickness of feathers	1⅜	1⅜	1	1	1⅛	1
Depth of feathers	6	5	8	1¼	5¼	4½
Breadth of bottom flange for bottom	6	3½	none	none	none	3½
Thickness of ditto	1⅜	1½	none	none	none	1⅜
Number of bolts in ditto	36		none	none	none	30
Diameter of bolts	1¼		none	none	none	1
Amount of projection of bottom into cylinder	none	none	none	none	none	none
Kind of joint	rust	rust	none	none	none	rust
Breadth of bearing or fitting ring	1	1⅜	none	none	none	¾
Diameter of hole for boring bar	none	none	18	14½	18	none
Plug to fill hole put in from outside?	none	none	no	no	no	none
Plug how fixed	none	none	with keys	with keys	with keys	none
Length of bearing, or fitting space	none	none	1½	1½	1½	none
Depth of socket for plug	none	none	9½	6	6¾	none
Thickness of socket	none	none	1½	1½	1½	none
Taper upon plug	none	none	2	1½	1¼	none
Number of keys for fixing	none	none	4	4	4	none
Breadth of keys	none	none	1⅛	1⅛	1½	none
Internal depth of cylinder	8 ft. 4	8 ft. 7	7 ft. 9	7 ft. 1	6 ft. 6⅜	5 ft. 8¾
Height of bottom above sole plate	3 ft. 0	10	10	4⅛	8¾	6¼
Kind of joint of cover	gasket	gasket	gasket	gasket	gasket	gasket
Projection of edge ring above flange	⅜	⅜	⅜	⅜	¼	¼
Breadth of edge ring	1¼	1¼	1¼	1⅛	1⅛	1⅛
Piece cast on cylinder supplemental to valve casing?	yes	no	yes	no	yes	yes
Thickness of metal of ditto	1½	none	1⅜	none	1¾	1½
Bosses cast on for bolts?	yes	none	yes	no	no	yes
Number of bosses	4	none	4	none	none	3
Thickness of metal of ditto	¾	none	¾	none	none	¾
Depth of ditto	3	none	3	none	none	3
Diameter of bolts tapped in ditto	1¼	none	1	none	1	1¼
Screwed at both ends?	yes	none	yes	none	yes	yes
Nozzles cast on for escape valves?	no	no	no	no	no	yes
Depth of port for escape valve	6½	5	4	4	4	2⅞
Breadth of port for escape valve	6½	5	4	4	4	4
Breadth of flange over all	12	10	9½	9½	9½	9½
Kind of joint	rust	rust	rust	rust	rust	metallic
Number of bolts in flange	6	5	5	5	5	8
Diameter of bolts	1⅛	1	1	1	1	1
Escape valves where situated	in port	in port	in port	in port	in port	end of cylin.
Breadth of bearing for diagonal stay	12	10½	11	10	9¼	8
Horizontal length of ditto	13	14	11½	11	11½	8¾
Perpendicular depth of ditto	18	24	16½	18	15⅛	11⅝
Bosses cast on bottom for holding-down bolts?	yes	yes	yes	yes	yes	yes
Depth of bosses	5	4	10	3¼	8¾	2¾
Thickness of metal of bosses	1½	1½	1½	1½	1½	¾
Diameter of hole in boss	3¼	2¾	2¾	2	2½	2⅛

OBSERVATIONS.

The sizes of the British Queen given are the sizes of the engines intended to have been put into that vessel by Messrs. Girdwood and Co.; but as they failed before the engines were finished, they were never finished at all. These engines were to have had two slide valves to each cylinder, one on the side of the cylinder next the condenser, and the other at the opposite side of the cylinder. The object of this arrangement was to enable the engineers to handle the engines easily and quickly: in starting or reversing only one of the valves would have been used. The condenser was situated beneath the cylinder, and that is the reason why the cylinder bottom is so much above the sole plate. The space usually occupied with the condenser was to have been appropriated to Hall's condenser, and the condenser beneath the cylinder was to have been used in the event of Hall's condenser becoming deranged, or not answering as well as was expected. The main pillars of the framing were to have been of malleable iron, fixed into strong sockets on the sole plate and cuttered through.

The whole of the joints in the recent engines of Messrs. Miller and Ravenhill and Messrs. Maudslays and Field are metallic, with one or two exceptions: but in Scotland this system has not yet come into general use. Not one of the engines the dimensions of which are given in the table, is provided with an expansion joint in the valve casing. The transverse joint in some of them between the cylinder and casing on the level of the cylinder cover, it is impossible to keep tight for any considerable time, owing to the unequal expansion of the cylinder and casing when the steam is up but the engine not working. The grease, too, that is apt to fall on the cylinder flange, is unfavourable to a rust joint in this position. The rust is de-oxidized by grease remaining in contact with it for a considerable time at a high temperature.

The plan of completing the flat portion of the valve casing above the level of the cylinder cover by a supplemental piece cast on the cylinder, is, we think, the best. Messrs. Maudslays' practice, in some of their recent engines, is to make the flange of the valve casing range with the flange of the cylinder, and then bolt to the top of the valve casing a length of D shaped pipe. This certainly is not by any means a neat arrangement, nor does it, we conceive, afford equal stability to the cylinder faces, as the mode of casting the flat part of this supplemental piece upon the cylinder itself.

ON FRESCO PAINTING.

BY JOSEPH SEVERN, OF ROME.*

(Continued from page 189.*)*

ON a former occasion (see *ante*, p. 189), I was not altogether aware of the difficulties that fresco-painting might possibly have to encounter in its introduction into England: perhaps my enthusiasm on the subject had a little blinded me. Being seriously anxious for the success of the experiment, I think it better now to review some of those difficulties which architecture, with painting, hand in hand, may have to surmount. But, to lighten a disagreeable task, I propose also to advert to the bright side of the subject—I mean the union of architecture and fresco-painting, as regards invention. It is a melancholy reflection, admiring and loving fresco-painting as I do, for its high capabilities as applicable to England, that from mere caprice it may be spurned by our artists as well as the public. This may arise from the singular apathy which prevails in this country with respect to painting as an intellectual art, as a moral power. Yet when the great simplicity of painting is considered, its universal language, as addressed alike, without the difficulty of translation, to all nations—to the learned and ignorant—to children, to babes—to all—it must be felt as a great power—and one, in this country, never fairly exercised; if indeed it has ever been exercised at all, which I doubt.

This English apathy with regard to painting as a moral power is such, that at this moment I know of nothing but the novelty of fresco-painting likely to recommend it to my countrymen; for, unless it can give "good things and understanding too," it will be regarded merely for its *material* interest, and not as the facile means of conveying a new and solid pleasure in opening the wondrous resources of art, and making painting rank with poetry and philosophy as a moral agent. More money is spent on the arts in England from one end of the year to the other than was ever spent before, or is distributed in any other country, or, perhaps, even in all other countries put together. But, in converse ratio to the money, is the time given to the arts. This is assuredly less than is devoted to any other intellectual pursuit: and here I come to the great evil—an evil for which I see no remedy but state patronage. The generality of English pictures are produced by our artists, without due consideration of the decorum and power of the art, and are of course looked at in the same light by the public; but when once a tone and a taste are given, by Government protection, and its connection with architecture, there is then some hope that these vast annual sums will be properly expended, that our homes will be adorned with instructive ornaments, and a new delight experienced by the English people. Without this, I fear that fresco, with all its capabilities—the good it will do to oil-painting in the education of the artists—the noble way it will call up the splendour of past English history—the opportunities it will give us to vie with foreign nations in the higher branches of art—I fear that all these advantages may be lost, and painting become subordinated to the upholsterer, who will reap the hard earnings of the artist, and take all the credit of his labours. So much we have to fear from the apathy of the artists and the ignorance of the public; for they may go on as they do now, charging each other with want of capacity, until the upholsterer steps in, like the lawyer in the oyster fable, eats up the prize, and gives an empty shell to each!

To avert this consummation, the first experiment must be made in an entire work—in a complete composition, bringing fairly together on a large scale all the powers of fresco, in which it excels every other manner of painting. Thus developed, I am certain some fine point of our history would strike every one by its simplicity and grandeur, two things unknown in our art now. I see, even at this moment, "in my mind's eye" young Richard the Second riding up to the rebellious crowd as their new leader and king, whilst Wat Tyler sinks confounded in death under the heroic blow of the Mayor; then the consternation and doubt in the King's attendants at the result, contrasted with the panic of the crowd—the action taking place in a large open space, admitting the crowd, the horses, and even the buildings of the time. Some such subject, fairly and honestly wrought, would insure the success of fresco. The English have too much love for dramatic history in books not to like it equally in painting, but it must be in a picture suited to them. I cannot but think that the adaptation of fresco to our English purposes and feelings is the only way to extend the sphere of history painting, as the powers it affords invention are greater than those admitted by oil-painting, and includes so many things in common with architecture. Nay, it is not too much to anticipate the creation among us of a new style of art, since the materials we have to work up and upon seem to be almost untouched. I think I am correct in observing that, as a people, we always search for something like a story in all works of imagination, and appreciate most of all the things which help to illustrate the story. This is an excellent groundwork for the British heroic fresco-painter. I think also, as I have been speaking of our ignorance of high art, I may fairly add, that our love for the other and lower walks of art has not been fairly noticed or appreciated, certainly not turned to account. During my absence from home, I was taught to believe that the English were dull and careless about the arts in every way, showing no feeling but the bad one of mutilating statues and scraping pictures; but my own eyes have taught me that these assertions are untrue. Consider the paying crowds in the exhibitions; is not this a strong example of love for the arts? Count the numbers who visit so respectfully Windsor and Hampton Court; is not this a genuine sign? Nay, take the more humble spectators who congregate and buzz about the print-shops, like "bees about a honey-crocke," and shall we not find in them symptoms of the most ardent love and the most elegant taste, if it were cultivated by education?

Now Fresco is to aid this cultivation, inasmuch as it will extend the art to history, and connect it with architecture; thus giving a purpose and a significance to painting, since I conclude the object of the building will always extend to the subject of the pictures. A succession of subjects illustrating the lives of our heroes will be demanded. The story, for instance, of our Alfred would thus form a kind of epic poem in painting, when done in architectural fresco, since the pictures may be united into a series, not only by the progressive relation of incidents, but by appropriate ornaments still farther illustrating the period. A suite of rooms in this way may be made as one, through which the gazer may walk with the same mental profit as he enjoys in reading history, for they will afford him a kind of animated reading at a glance.

Painting represents only one moment of time, but that moment comprehends the past and the future, since both must be implied to make the present action intelligible. Unless the subject admits of this, all the force of expression and the variety of character, all the costumes, the architecture, and the landscape are thrown away, for all must be seen at a glance, and that glance must take in the whole subject. Hence I conceive painting is the most natural and simple of the arts, and the best suited to convey a moral. How proud shall we feel to see the noble deeds of our forefathers warming up the walls of those buildings which are the result of those deeds! To see our Alfred, when a fugitive, singing to the Danes, and then conquering them—to see him modelling his little ships, and then building up his empire—to see him constructing a lantern and a clock—translating the Holy Scriptures—and compiling the laws of England, which still are standing like the rock of his own immortal fame, even to our days—the second thousand years bringing out their value tenfold. What heroic subjects are there to compare with this? for, while it has all the abstract beauty and sublimity of the true heroic, even to the charms of antiquity, it is at the same time about us—it is the element of the glorious liberty we live in—it is the power which has extended our empire round the world, in peace and liberty, in religion and philosophy. What bosom can be insensible to such deeds, when they are represented on a scale worthy of their grandeur? but this can only be accomplished when painting is assisted by architecture—when it has the aid of grand proportions—when its figures are life-size at least—when its backgrounds are ample—but most of all when the use of the building it adorns has suggested the choice of subject.

It is true that the art of painting is only to be acquired by years of devoted attention, but this does not apply so much to the inventive as to the mechanical part. The story told by a picture should be intelligible to all. I can well remember, when a boy, the strong impression made on me by the cartoons of Raffaello, which raised an interest and curiosity in my mind that led me not only to read the particular chapters explaining the important scripture subjects they present, but also to begin anew the entire reading of the Bible, with the first love I felt for it, and certainly the first intelligence about it. To those who infer that no benefit can come from the fine arts I would address these remarks, for is it possible that when Raffaello has given us those immortal pictures, more than sermons, that we should still look down on the art as a thing merely sensual? Is it possible that the dying Ananias, extended on the ground before the Apostles, who call down the vengeance of Heaven on his uncharitable lie—whilst even, when his horror-struck friends fall back from him, his unconscious wife behind is still counting the money which is purchasing for her the same fearful doom—can be beheld by any religious man without awe? If so, I am sure he would sleep over the best sermon on the subject.

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* We are indebted for the continuation of this paper to the *Athenæum*.—EDITOR.

The true object of historical painting is to compress into one compact whole all the important points which in books are scattered up and down through many pages, so that the entire power of the subject shall strike at a glance. This is completely done in Raffaello's splendid composition of St. Paul preaching at Athens. Here the whole subject, which in the New Testament occupies a long chapter, is concentrated in a single look. We enter the picture by the steps whereon the Apostle is standing with upraised arms, communicating that divinity which inspires him. We distinguish the various Athenians congregated about him. Dionysius and Damaris in the foreground are in the moment of conversion to the Christian doctrine of the resurrection, and the similarity of their attitude to the Apostle himself at once implies that they believe his doctrine, and receive the Holy Spirit. Near them is the Stoic, who ponders over the resurrection of the body, more puzzled how it can be than questioning that it is. The Cynic stands next leaning on his crutch, and listening with an ironical sneer. The elegant Epicurean smiles incredulously. Beyond are congregated the disputants of the academy, lost in their own opinions, save those of Plato's school, who show an elevated attention. Contrasted with this is the rankling malice of the rabbi—the magician's mysterious glance. And all these various persons are assembled on the Hill of Mars, as described in the 17th chap. of the Acts of the Apostles. Now it must be evident to any one who will be at the pains to examine this sublime work, that no description can produce the instantaneous effect of seeing all the persons brought together in one scene. Is it possible that a work approaching so near to the sacred description itself, and partaking of its sacred character, should not claim our deepest attention? Yet it rarely gets any attention. At Hampton Court may be seen crowds passing heedlessly through the room which contains these, the finest works of Raffaello, who have perhaps bestowed hours of attention on everything else. Why is this? It is the mistaken locality. It is that these works, which are of the most sacred character, should be shown in a sacred place, which would inspire a devotional feeling, necessary for the entire understanding as well as the feeling of their thoughtful beauty; for how few persons are there, even amongst the high and educated, who are able to abstract themselves so suddenly from the profane so as to appreciate these PICTORIAL SERMONS, in the midst of art's gay profanities, which on every side surround them. It is too much to expect that Raffaello's cartoons should duly arrest the attention, placed as they are at Hampton Court. I remember another example of the truth I would express. The late gifted historical painter, Hilton, produced a fine work of the Crucifixion, which was admirably painted, designed, expressed, and on a sufficiently large scale. This picture was exhibited at the Royal Academy, and excited little or no attention; it was not even (as I am assured) noticed at the grand annual banquet, when all the most distinguished personages of the state are present. This I also find natural and proper; for how was it possible to look in a right spirit on the agony of our dying Saviour, in the midst of a splendid and social festival, or even in an exhibition made up of happy smiling ladies and courteous gentlemen? Now this brings me to the great good of painting being united to architecture, in the introduction of fresco, where, in becoming part of the walls it must of necessity partake of the object of the building. Of this good I will mention one singular and signal example. That noble picture by Leonardo da Vinci, in the Milan Convent of Santa Maria della Grazia, representing the "Last Supper," is almost unintelligible to us as a composition, without due consideration of its locality. This is admirably pointed out by Göethe. He saw the refectory, with all its religious members at their solemn meal. Opposite to the picture stood the prior's table, the monks sitting down the hall on the right and left; so that you will perceive at once that the painter in the composition endeavoured to make his great work fill up characteristically the other end of the room. No doubt he made it correspond in everything—the table-cloth with the corners tied up, the dishes and the drinking-cups of the time and place. By this interpretation is answered the objection continually made, that the figures are all sitting on one side of the table, for the monks always sit so in a refectory. I cannot bear to allude to this wondrous work without speaking of its deep and impressive character. When you stand before it you almost hear the tremendous secret which our Lord declares at the supper—"*I say unto you, one of you which eateth with me shall betray me!*" Now who would believe a picture *could* represent such a moment, unless he had such a work? The dreadful accusation falls upon every one save the beloved disciple John, and at once calls forth the varied expressions of men accuse of such treachery. The gazer may easily make out each Apostle by his individual character and expression, as each one endeavours to show his innocence of the charge. Judas is known by the money bag, and by his knocking over the salt. What an appropriate subject for a refectory! The well-known story told by Wilkie of a similar picture in Spain, will serve to show the great moral of such a work. An aged monk, observing him unusually interested, said to him, "Ah! you cannot feel the interest I feel in that picture, for I have sat before it at my meals some seven and forty years, and such are the changes which have taken place in Spain, so many companions have come and gone in the time, everything changing but that picture, that when I look upon it and its solemn company, I almost believe in truth they are the substance, and we but the shadow." There can be no doubt that Hilton's picture of the "Crucifixion" lost as much as Leonardo da Vinci's gained, by the locality and its associations.

Following out the same principle, we may thus have pictures adapted to the church, the palace, the theatre, the exchange, the hospital, and even to the private dwelling. Each will suggest its own just and proper association to painting. I am certain that the art, in its highest destinies, is greatly dependent on architecture, which best awakens those associations necessary to its appreciation.

Again, are we not dependent on painting for the precise representation of places which we have never seen? Can anything be dearer to us than painting in its remembrance of the illustrious dead, or those who were dear to us? Are we not dependent upon it and sculpture for the very existence of antiquity? have we not the most distant climes at our fire-sides, and the people of the antipodes made our very companions? and yet what I have enumerated, are but the limited performances of painting, and in no way to be *compared* with its achievements when it raises itself to the representation of history on historical walls. Is it not wonderful to have realized to our sight the actual scenes of the past;—to have the persons of bygone ages alive again, their proper selves, and in full action, expressing their noblest deeds? Were the art realizing such powers, such delights, a new discovery, it would be crowned as the immortal flower of the world—as a supernatural power, re-creating the world which is past. But, dulled and kept down as it has been by its servitude to common uses, in a commercial and a political society, it only now begins to look up for emancipation in the midst of general improvement. It begins to spurn the prison walls of an exhibition-room—it longs, it demands to be free like the other arts. We used to be told that the African slave was an inferior being, and only fitted even for servitude by blows instead of laws; by a like injustice has the art of historical painting been depreciated in this country to a mechanical level, worthy only to point out the alehouse and the gin palace.

But are not those who bring forward such charges wilfully mistaken? Can such works as the cartoons of Raphael be passed over with indifference? have they not a claim on our sacred sympathies? Are we not rejecting in part our blessed religion, when we reject this powerful resemblance of it? for how can our senses receive the impression of the one and not of the other? I tremble at my own rashness in saying this; for in this country, if there are works of art in a church, we are not allowed even to look on them. In our cathedrals rails and men are employed to prevent us from taking more than a glance even of those monuments erected at the cost of the nation. We may take a hurried look, in the week days, but are never allowed to read an inscription, or to linger on our way. Such a system is only worthy a conquered people, whom it is feared to inspire *with their nationality;* such things are intelligible in Poland, where it is thought expedient to extinguish even the *native* language, but I cannot imagine the object here. I would fain hope that a pictorial Wilberforce may rise up with fresco painting, and emancipate us from these slavish customs, by opening the public buildings, even to the churches, and showing the public monuments freely. Here would be a new and powerful source of education to an inquiring people like the English;—the government, the church, the laws, and the people, would be *thus* brought nearer together by the arts; and in showing how many illustrious individuals have arisen from the lowest ranks, the most powerful incentive would be offered to the ambition of all endowed by nature with genial impulses and generous feelings.

Another slavish prejudice to be done away with by the union of architecture and painting is, our narrow-minded custom of allowing a man to do, or to understand, only one single thing, when the services of Professors generally are required in divers things. Professors may acquire knowledge, but woe betide them if they attempt aught else but the one particular thing which they profess! For this I cannot account, as in all ages—save our own—a man useful to the public has been expected to possess a kind of universal knowledge to assist him even in his own particular branch, so that he might be at the public command on any emergency. It would seem very odd now, if the State were to call on the Duke of Wellington to take his brush and commence the fresco painting in the new Houses of Parliament; and yet such a call was not uncommon in the fifteenth century. We hear of Michael Angelo summoned from his labours in the Sistine chapel, to prepare without delay the fortifications of Florence, then expecting a siege. We hear also of Leonardo da Vinci, on being invited to paint for the Duke of Milan, beginning his labours by making canals and bridges; and yet, I apprehend, his sublime picture of the Last Supper did not suffer from this abstraction, for it still remains a miracle of art; or that Michael Angelo's fortifications did not help the less to save the city, although he was painting fresco just before at Rome. This universal knowledge is one of the characteristics of the fifteenth century all over Europe. We find similar examples in our own country in the time of Elizabeth, particularly in the class of soldier-poets, and such like men, even music being included in the accomplishments of a complete gentleman. I do not insist now on the necessity of possessing this variety of power; but I would declare, as regards painting, that our present slender circumscribed knowledge can never produce historical painters, or even their patrons. It must be universal knowledge and love of the arts, not only as regards itself, but as regards its connexion with all other arts and sciences. I want to see my deserving countrymen, the English painters, ranking with the best, and British painting arm-in-arm with poetry and philosophy, which it is not now, in place of grubbing among the mechanical trades, with an exhibition room here and there, as "a house of call for painters and glaziers." The liberal encouragement of painting must be advanced, not by our painters shutting themselves up and prowling about with it a secret, save on the temptation of a five-guinea lesson—no; the casket must be unlocked and the key thrown away, and the public instructed in the principles of art. There are no secrets in art; though art is not to be understood without an effort on the part of the public, and is only to be acquired by artists after long years of ardent and sincere study. The greatness of painting must be in its difficulty, and not in its secrecy. It must be in its principles and not in its vehicles; the public must become, as it were, a scholar to the painter. And why not? Why should not the artists themselves try to mould and form that love which, I am certain, exists in the English people, into something like knowledge?

In the education of painters, fresco will exercise all these good influences, inasmuch as it tends to raise them to a true sense of the universality of painting. It must give them, in a pecuniary point of view, the sustained though moderate reward of years of constant employment, instead of the intoxicating, lottery, chance system of the present day. We shall now have the excellent old Italian plan of master and scholar, as in the production of such extensive works many must be employed, and the result will be advantageous to both; this we know was the greatness of Raffaello, whose scholars partake his fame, and so on down to Rubens, and his scholar Vandyke.

Another great result will be to emancipate the art from the trammels of booksellers, who, for more than half a century, have made inventive painting subservient to their speculating purposes as a mere trade. This has kept historical art back in comparison with the many things in which England *surpasses* the rest of the world; for what can be more servile than the vicious system of ornamenting books, in which the greatest English painters have exhausted and consumed their minds with little fame and less fortune? We have but to point to Stothard as a sad example; he is said to have produced some five thousand inventions in this way! The art has sunk under such baneful influence, and when pandering to the book trade in Annuals and such trash, has ceased to be worthy the name of painting. This state of things does not exist anywhere but in England, and is one of the reasons why we have not been able to make another grand age of art. But our painters must now turn their attention to the ornamenting of buildings, and not books.

The State itself must deal in painting and engraving, and directly reward the artist, if it desires to have art that shall be worthy the English name. This may be done with the outlay of comparatively small sums, indeed it cannot be by the actual money expended, so well as by the direct intercourse of the highest personages in the country with the artist, by a kind of friendly and cheap patronage (if I may so express it,) whereby the artist is drawn out of his own narrow circle, and paints not only his own mind, but the mind of his patron. This can only be done effectually in national subjects, and I know well that the Munich artists have always worked, and prefer to work, for their intelligent King, at a moderate rate, to being employed at double the sum by unintelligent persons. Even as regards his fame, the artist is content on the score of being employed by his sovereign. It is a great mistake in this country to suppose that the encouragement of the arts by the State would be an expensive thing. To get private patronage the English artist is obliged to make an expensive tradesmanlike figure—this not only takes up half his time, but it takes all his money; whereas the simplicity of his life, were he publicly employed, would enable him to bestow double the time on his works, give them, of course, more study and perfection, and create a higher style of art. No doubt, the true reward of an artist is the interest his patron takes in the work. Do we not hear of the restless anxiety of Pope Julius to see Michael Angelo's unfinished paintings? Did not the Emperor Charles V. find time, amidst his active life, to caress Titian, and learn the art from him? And thus it was with Da Vinci and other great artists, whose inventions were quickened, and whose patience sustained, by such an honourable sympathy. For how can an artist excel in a work "where dawns the high expression of a mind," if, when complete, it is to be received into his patron's house like a chair or a table? Pounds, shillings, and pence can never stand for painting, sculpture, and architecture; we must have patronage, study and love. In a country where the historical plays of Shakspeare are still listened to, and where the people never tire of hearing Handel's oratorios, there can be no despair of historical painting being encouraged, when it is properly put before the public, for it requires as great a mental effort to relish the one as the other. English painting is far behind these. We are in it what the ancients were in geography, when they believed the earth to be a plane surface. We are afraid to go to the real boundaries of art, and so we coast it along, like cowards, from place to place, as though there were no such thing as the loadstone of art—as a painter's compass. Let us look for remedy in enlightenment. Fresco is the fearless guide, and, with design for our helm, we shall soon be gloriously sailing on the independent sea of art.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.

LECTURE X.—ON THE UPPER WORKS OF RAILWAYS.

This lecture was on the Upper Works of Railways, which term, the Professor stated, was intended to comprehend everything above the bed or formation level of the roadway—viz., the gravel, broken stone, or other road material, technically called the "ballasting;" the stone blocks or wooden cross sleepers, laid thereon; the chairs and rails, and their fastenings, as attached to the stone or timber supports; and the boxing or filling up of the road material around these supports, when the railway is finally laid to the proper gauge, range, and level—the whole of the materials and adjustment forming the "upper works"—an expression borrowed from the German *oberwerke*. The depth from the road-bed to the level of the rails, of all these parts, as permanently laid together, is seldom less than two feet, when a good way is to be insured; the principle to be observed being to have the ballasting of such a material and nature that water will percolate freely through, as clean gravel, cinders, quarry rubbish, coarse sand, &c. The word "ballast" is a northern provincial term. Some of the first railways were introduced into the vicinity of Newcastle-upon-Tyne, Shields, and the neighbouring coal shipping ports, and it being found necessary to have a bed or layer of some material, to receive the railway track, the same not to be retentive of water, the gravel brought by the colliers from London as ballast, and accumulated in hills or spoil-banks near the sides of the harbours, was found to answer the purpose very well; the expression has since become common for whatever other material was similarly used for laying railroads. Mr. Vignoles observed that a great number of other technical words now in common use, when treating on railway works, were provincial terms, chiefly from the north of England. When the bottom of cuttings, or top of embankments, are of soft material, it was recommended to make a kind of pavement or hard layer, on the forming level, below the ballast. On embankments, until they became well consolidated, this pavement would not perhaps be conveniently put in; still means should be contrived to carry off the water quickly from the surface, and the Professor insisted much on the free introduction of blind, or French drains, of broken stone, among or under the ballast, connected with the open side drains, which should never be omitted in cuttings; on embankments these cross rubble drains should go free of the road-bed, with water channels down the slopes, of sods, or more substantially formed if needful.

The bed of the railway having been prepared on the above principles, next came the consideration of the railway itself. The substance first used for this trackway was wood, and afterwards a metal rail, plated on the wood: after 200 years' trial of different systems—for so long was it since the fir colliery wagon-ways were introduced—the Professor observed, we are just coming back to the original form and material as best adapted for the purposes of a railway—viz. timber laid longitudinally. When blocks of stone are used to support the chair and rail, weight seems to be sought for as desirable, and the general cubic contents of such blocks as are considered proper for a good way are about five cubic feet—viz., 27 inches wide, and a foot thick. When cross bearers of wood are the supports, each sleeper, as it is termed, contains about two cubic feet of timber, being about seven feet long, with a transverse section of 40 square inches, being full eight inches broad, and averaging five inches thick. The intervals at which the blocks or sleepers are placed vary from three to five feet, according to the weight of the rail or of the load. With these descriptions of supports, it becomes generally necessary that a chair or saddle be attached thereto to receive the rail, which is seldom fastened directly either on block or sleeper, without the intervention of this contrivance of a chair, unless when the rail is made wide and flat at the base. Such shaped rail is now much used on cross bearers of wood for temporary railways, by contractors, while executing works. Mr. Vignoles said this form of wrought iron rail was first introduced nearly 12 years since on the St. Helen's Railway, by some contractors, at his suggestion, and the same rails were lately in use by the same persons, and still good and serviceable, after continued use. Of late it had been recommended by many engineers—among which Mr. Vignoles believed he was among the first—to lay down the railway bars on bearings of timber, disposed lengthways in the direction of the way, and upon which the iron had a continuous bearing, instead of having it supported at intervals (either with or without chairs), as was the case when blocks or cross timber bearings were used. In describing the different modes of laying rails, the Professor observed that the heavy stone blocks being packed around, or boxed up with ballast, kept the rails in place—that the cross sleeper having both rails attached thereto, the gauge or breadth was preserved; with the longitudinal system of bearings, the parallelism was retained by cross ties of wood, with tenons, and sometimes by rods of iron with screw-ends and nuts, and occasionally with both. It was necessary thus to provide for preserving the breadth of the railway, for, as the carriages and engines work along the rails with a wriggling motion, there is always a tendency, by the lateral action of the flanges of the wheels, to push the road out of gauge. Mr. Vignoles mentioned the two new lines added on the south side of the London and Greenwich Railway as the latest examples of longitudinal timber bearings; but he observed that, as the great point in this system was to insure that the rail be firmly attached to the wood, to prevent any vertical play, he considered a more effectual method might have been there used, so as to have the iron continually united to the timber, on a plan which he had tried with success, and to which he would presently advert. When iron was first introduced for railways, it was for a long time merely a plating of metal on the edge of the wood rail, on which plan, with iron bars of greater or less weight, many of the lines in America had been laid.* Cast iron being next introduced, the system of fastenings was necessarily changed, and the original longitudinal timbers abandoned for cross sleepers, or isolated stone blocks. The rails being cast in lengths of three or four feet, it was found expedient to prepare some contrivances to receive and fasten the ends together, and this was the saddle or chair. Some of these iron rails were cast deeper in the middle, and, from their shape, got to be termed " fish-bellied," this form being probably adopted with the idea of obtaining uniform strength; though, for railway purposes, the position of this increased depth was the reverse of that given to bearers intended to resist quiescent weights. From the action of the moving weight, however, upon rails with so many joints, they soon got out of order. Wrought iron was then introduced, to get greater lengths; the first of these were rolled at a considerable expense of useless ingenuity into the same form as the fish-bellied cast iron rails, the length of 15 to 18 feet being divided into five or six flat ellipses. On most of the lines where this description of rails was first laid, it has been found necessary to take them up, and replace them, as they were found to break at a short distance from the points of support. Mr. Vignoles stated that he had, from the first, decidedly set his face against this form of rail, and argued for and introduced rails with the same section throughout their length—since commonly styled *parallel rails*, as distinguished from the " fish-bellied rail," adding 10 lb. to the original weight of 35 lb. to the yard, by putting on a lower rib or web, on the principle that gave such additional stiffness to all beams; this lower web was increased in size from time to time, until, in a special report to the London and Birmingham Railway, Mr. Vignoles recommended that the upper and lower webs, or buttons, should be made precisely alike, to allow the rail to be turned up or down, or in either direction. This form was, however, first actually laid down by him on the North Union Railway, and its advantages in the above respects have already been appreciated and applied: these rails are about 65 lb. to the yard. The Birmingham Company decided finally on adopting this form, increasing the weight to 75 lb.; and, where chairs are used, it is now almost exclusively employed, the weight being sometimes increased to 78 or 80 lb. per yard. With the increase in the weight of the rail, the intervals between the supports also gradually increased from three to five feet, but with bad effect, as the expense of keeping a railway in order with the longer bearings (as the technical phrase is) was very much augmented; and, on the London and Birmingham Railway, intermediate supports had since been introduced, where the original bearings were five feet. Mr. Vignoles stated it as his opinion, deduced from considerable experience and observation, that where chairs and supports, at intervals, were used, he considered a 60 lb. rail, with a 3-feet bearing, better than a heavier rail with a longer bearing. Blocks, he observed, were, however, nearly exploded as supports; the cross sleepers and chairs were still preferred by many engineers, but it was certain that the closer the supports—that is, the shorter the bearings—the less the cost of maintenance, and hence the inference, which experience everywhere confirmed, that the continuous supports were best of all. In respect of fastening the chair to the block or sleeper, and the rail to the chair, it was now almost universally admitted and acted upon, that compressed wood was much preferable to iron spikes, bolts, or keys. Mr. Vignoles introduced a number of drawings, and described a variety of diagrams, illustrating the various shaped rails and chairs, and modes of fastening adopted, and drew comparisons as to the advantages and cost of each. In reference to what he had before stated of the disadvantageous method hitherto pursued in fastening rails with flat bases to continuous timber bearings, by spikes or screws, the Professor said that such a mode seldom continued to hold the rail close down to the timber, and there ensued a certain quantity of vertical play of the rail on the wood, often accompanied with a good deal of rattling, and in the end, the head of the bolt or spike was absolutely jerked off. Mr. Vignoles said that the only effective fastening was that used with Evans' patent rails, which had a slit or groove of a dove-tail shape (in cross section) rolled for the whole length of the rail in the bottom; bolts, with similar-shaped heads to fit, were passed into this groove, and dropped at the necessary intervals, through holes in the longitudinal timbers; the bolt terminated in a screw, and a washer and nut being put on, by means of a spanner, the nut drew down the rail closely to the timber. Mr. Vignoles stated that he had had a considerable length of railway thus laid, which had been done some time, and the rail had remained close down on the wood without any play, or getting at all loose. He concluded this lecture by stating that in the next he would endeavour to draw a comparison between the modern heavy rail and chair and fastenings, as used with cross timbers laid at intervals, and the rail and fastening, as above described, to be laid on longitudinal timbers, and having a continuous bearing thereon.

LECTURE XI.

In resuming the subject of the Upper Works of Railways, the Professor said he would enter briefly into the consideration of the strongest form of rail, after explaining those points applicable alike to cast and wrought iron bars. First, a certain breadth was required for the bearing surface of the rail, for the wheel to run upon, and this breadth should be such as not to be likely to produce improper action or grooving, in the tire or tread of the wheel, and, at the same time, not to be increased so as to make the rail needlessly heavy; there must also be a sufficient depth or thickness of that bearing surface, to make it strong enough to withstand abrasion, and render the rail sufficiently stiff, and capable fully of sustaining the action of the driving-wheels of the locomotive engine. Hitherto the established breadth seemed to have been about two and a half inches on the top web, or button, and Mr. Vignoles thought, from experience, that that breadth should be considered the *minimum*; however, the strength of this bearing part of the rail, being as the breadth and square of the depth, a greater breadth than absolutely necessary to prevent the tire of the wheels being grooved, would add to the weight of the rail, without increasing the strength more than in the direct ratio of the breadth, whilst the same quantity of material, disposed in terms of the depth, increases the strength in the duplicate ratio. Considering the great increase of weight in the locomotive engine of late years, and the continued wear and tear on the rail, from the action of the driving-wheels, and looking to the state of the iron of the upper works of those railways which have not very heavy bearing surfaces, it would seem that, while two and a half inches is a *minimum* of breadth, the chief attention is now required to the proper depth, to resist abrasion and exfoliation which takes place, especially if the iron is not perfectly well rolled. Railway bars are compounded of fagotted iron, and if the pieces are not properly welded the bearing edge is broken down, and peels off; but, supposing the iron good, and the manufacture perfect, the heavy effects of the engine must be provided against, and experience shows that an inch and a half is not too much for the depth of the top web, or bearing part of the rail, and two and a half inches being the breadth, then three and three-quarters—or, say four square inches—should constitute the sectional area of the part that is exposed in receiving the direct action of the driving-wheels; this is the section actually requisite, and the greatest additional strength being to be obtained by increasing the depth, if possible, this is the point to be attended to. It thus appears that a weight of 36 lb. per yard is required to sustain the engine, and all beyond will belong to the mode of attaching the rail to the support below.

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* See *Journal*. No. 1, Vol. I.

In treating of the wear and tear of rails, Mr. Nicholas Wood has given some curious and interesting results of experience; but the weight of the locomotive engines used is stated to have been only 10 tons, and of this the weight on the driving-wheels would probably not exceed six or seven tons. The result of a variety of experiments on the malleable iron rails of the Stockton and Darlington Railway gave one-tenth of a pound per yard as the absolute amount of fair abrasion; some statements, however, made it much higher, being one-sixth of a pound. On the Killingworth Colliery it was one-eighth of a pound. On the Liverpool and Manchester Railway, some years ago, three rails were taken up, carefully cleaned and weighed, relaid, and taken up again at the end of one, and again at the end of two years: the wear was found constant, and about one-tenth of a pound per yard per annum. If we were to take this to be the true wear, and suppose it to arise wholly on the upper surface of the rail, the result would be but the 84th part of an inch in depth, and it might be supposed to take 100 years to wear away a rail from mere abrasion. But later experience shows that the increased weight of engines acts very destructively on rails whose upper webs are not sufficiently strong, and of the best manufacture. We may take 10 tons as the present average weight on the driving-wheels of a locomotive engine; and, if this is to be effectually provided for, the button, or bearing part of the rail, must not be less than 40 lb. to the yard. Now the form of the remaining part of the rail will depend upon the manner in which it is to be fastened down to the support below, either by being fixed in a chair, which is itself to be again fastened to something else, or by being screwed down, as the rails on the Great Western, Croydon, and the new part of the Greenwich Railway; or, finally, secured in the simple manner described in the last lecture. A comparatively very small addition to the theoretical form of rail to be sustained in a chair, gives a section which has the advantage of being capable of being turned in either direction, or vertical position, and hence the top and bottom of the rails have, of late, as previously stated, been made equal and similar, connected by a neck of proportionate dimensions. With the present heavy rails, of nearly 80 lb. to the yard, the average weight of the chairs, including the joint chairs, may be taken at 20 lb. per yard, reducing the intervals of support to that constant distance. Thus, we have an aggregate of nearly 100 lb. weight of iron per yard of each single rail. If, then, we could in any way get rid of the extra weight required to fasten the rail into the chair, and dispense with the chair altogether, it seemed to Mr. Vignoles to be desirable to do so, provided the object in view was equally well attained; and he contended that such would be the case with a 50 lb. rail attached, in the mode before described, to a longitudinal bearing of timber; for the whole strength of the upper or bearing part would be retained, that being as the breadth and the square of the depth; thus, with a weight of iron just one-half, would be equally efficacious, and it only remained to compare the supports in either case. Now, as stone blocks seemed to be discarded by universal consent, the question of the supports below is narrowed to that of *transverse* or of *longitudinal* wood sleepers. Sufficient experience had been obtained to warrant the conclusion that, for the purposes of this argument, the cost of fastening and of laying the rails, ballasting, drains, &c., taken as a whole, were nearly the same for both systems, and it only remained to contrast the quantities of timber, and, always considering a locomotive line to be the one to be made, it may be stated that this cubing was about double for the longitudinal system to that in the transverse method of laying the sleepers. In short, looking at first cost only, there was a saving of 100 lb. of iron, and an increase of two cubic feet of timber in each yard of single trackway of the former over the latter mode, so that strictly the longitudinal system was the cheapest; but to avoid minor objections, let the cost of each be taken to be the same, which was giving a decided concession in favour of the transverse system. But this was a very narrow view to take of the question, which wholly omitted the economical results from diminished wear and tear of the engines, of the railway, and of the carriages, as had been most especially exemplified on the Dublin and Kingstown Railway, where the massy granite blocks originally laid down had been all replaced by longitudinal sleepers, and though the old light 45 lb. rails and 15 lb. chairs were retained, the diminution of the annual maintenance was most remarkable, though there was not a railway in the United Kingdom where so many passengers were carried daily throughout the year.

The expense of keeping up the double way, now that the system of longitudinal timbers has been quite carried out, is less than one-third of the corresponding expense per mile per annum of maintaining the London and Birmingham Railway. Mr. Vignoles then read a variety of tabular results of the cost of the three various systems, going through all the details, and pointing out the exact measures and quantities, and stating the actual expenditure on the upper works of various lines of railway. The result seemed bed of the road was duly prepared, including all the items under that that, for a double line of railway—upper-works, properly laid after the head, which were enumerated in a former lecture, and calculating, for the present heavy and powerful locomotive engine, that no less a sum than £5000, and, in most cases, £6000, per mile was necessary, and that, in many instances, it had reached nearly £7000—the market price of iron and timber, also the quality of the latter, the greater or less facility of obtaining materials for ballast, &c., affecting the amount, and these large sums were independent of the earthwork, masonry, land, fencing, management, stations, carrying establishment, &c. Mr. Vignoles also gave a number of drawings and diagrams contrasting the three systems, and exhibiting, in a very explanatory manner, the modes of laying and fastening. He also exhibited the rail, chair, and fastenings, for the transverse method, with all the recent improvements introduced by Mr. Cubitt on the South-Eastern Railway, and as manufactured by Messrs. May, of Ipswich, and then produced the rail with the dove-tailed slot, and the mode of attachment to longitudinal half baulks of timber, repeatedly alluded to in this and the preceding lecture, observing forcibly, that, if the same effective results were obtainable by the latter simple method as by the former complicated one, it was not only to be preferred in this kingdom, but was peculiarly eligible for such countries as Russia, Poland, Germany, in general, France, and America, where wood is usually in great abundance, and where iron is comparatively scarce, especially in the form required for railway bars, and, of course, the prices became in proportion. Mr. Vignoles quoted largely from the works and reports of Tredgold, Barlow, and Lecount, and stated a number of mathematical and empirical rules laid down by those authors, which, he stated, were chiefly relating to rails supported at intervals, but, though he felt it right to lay them before the class, he considered that farther experiments and investigations were requisite, and particularly in reference to the perfect combination in one support of the iron and timber in the longitudinal system, as explained and avocated by him, of which the Professor insisted, the great advantage and peculiarity was that of obtaining a perfect fastening, independent of the fibre of the wood, or the tenacity of the screws or bolts therein, and of obviating the hitherto well-founded objections to the mode of attaching rails having a continuous bearing, which had not been able to prevent a vertical play of the iron on the timber.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

TWELFTH MEETING, 1842.—*Held at Manchester.*

(Continued from page 277.)

REPORT ON EXPERIMENTS ON THE TRANSVERSE STRENGTH OF HOT AND COLD BLAST IRON. By Mr. Fairbairn.

THE bars, as described in the former reports, were supported by standards, 4 ft. 6 in. apart, and were loaded with different weights; they were occasionally carefully examined, and showed a very slight progressive deflection. He had no doubt that they would ultimately break, but the progress was very slow. He read a table showing the weights laid on, and the deflections of each bar.—Mr. Hartopp said, that Mr. Fairbairn's former experiments on hot and cold blast iron had created a false impression with regard to the strength of hot blast iron. Mr. Fairbairn had found very little difference between the hot and cold blast; but his experiments, made with great accuracy, and in which the weights were laid on with great care, were of little practical advantage, as these were not the circumstances under which iron was tested in practice: there percussion, violent and sudden impact, should be expected, and here lay the great deficiency of hot blast iron. Even in Mr. Fairbairn's experiments, Oldberry No. 2, cold blast, bore twice the percussion of Oldberry hot blast; and Milton hot blast was only half the strength of Elsicar cold blast, made of the same ore and smelted with the same coal. Experiments had been made in Yorkshire with great care; the results being, Low Moor cold blast bar iron, 3 in. diameter, broke with 6 blows, ditto Scrap, 3 blows, ditto hot blast, 1 blow; again, Low Moor cold blast 18 blows, Bierly ditto, 18, hot blast of as good materials, 3 blows; again, Elsicar cold blast, 21 blows, Milton hot blast, 1½ blow; therefore, in iron for axles this difference of at least five-sixths of the strength was very important. As to scrap iron, it bore too high a character. Scrap, made on the old plan, was all charcoal iron, but the modern scrap iron was very inferior, being 32*s.* 6*d.* per ton cheaper, so that ironmasters put off as much of this cheap material as possible. Hot blast iron was rejected now for water-pipes, &c., and even for cannon balls; and, in fine, he had been told by very eminent marine engine makers, that where any percussion took place, hot blast cast iron was only half the strength, and wrought iron only one-sixth the strength of cold blast.

Mr. Fairbairn explained, that he had found great difficulty in obtaining specimens from the different iron-masters, who would of course send, when possible, the best specimens, but every care had been taken to insure accuracy in the experiments.

Mr. Hodgkinson said that the average strength of hot blast had been $\frac{3}{100}$ weaker than the cold, but the inferiority was chiefly in the softer irons; as the hardness increased, the two kinds approached to equality, and in the hardest irons the hot blast was the best. He thought his experiments, made without any interest on either side, and with the greatest care, were more to be depended on than experiments made by those who had an interest in the result.

Professor Vignoles explained, that the question of hot and cold blast had nothing to do with the late contract for cannon balls.

On the Form of Ships.

Mr. Scott Russell laid on the table the *Report of a Committee on the Form of Ships*. It contained upwards of 20,000 observations, the result of careful experiments on the resistance to models of ships of more than a hundred different forms and sizes, and extending from small models of 30 in. long, to vessels of 25 ft., 60 ft., and 200 ft. long, and above 1000 tons burden. These experiments were under the general superintendence of a Committee of the Association, consisting originally of Sir John Robison, Mr. Scott Russell, and Mr. Smith. Unfortunately, the ill health of Mr. Smith's family had altogether deprived the committee of his advice and assistance, but the observations were personally conducted by Mr. Scott Russell, who had to acknowledge the pleasure he had derived from conferring with his friend Sir John Robison, with whom he had frequent occasion to consult during the progress of the observations. The smaller experiments had been made in a reservoir in the ground attached to his (Mr. Russell's) residence, and the larger ones in the open sea. It was probable that these results, maturely digested, and illustrated by accurate drafts of the forms of the ships subjected to experiment, would be published in such completeness as might be practically serviceable to the naval constructor and mercantile ship-builder; and he would, therefore, confine the present report to a general account of the objects contemplated in the experiments, and the method by which these designs had been carried out. Several series of experiments have already been made, both by scientific bodies, and by public-spirited men, for the advancement of naval architecture. These had cost large sums of money, and consumed much valuable time and talent. To most of them it had been objected—unhappily not without reason—first, that they had not been conducted with an adequate knowledge of the wants of the constructor; secondly, that the forms of bodies submitted to experiment were by no means such as are used by the ship-builder; thirdly, that the scale on which these bodies were constructed was too small to claim for the results, as applied on a large scale, any considerable degree of confidence; fourthly, that it had not been established by what law the results of experiments on one scale of magnitude are to be transferred to a different scale, either greater or less; and, fifthly that the apparatus formerly used was liable to errors which it was difficult to eliminate from the results. To obviate such objections was one great object in these experiments. Mr. Russell had contrived a new apparatus, which was so simple and convenient, that a uniform propelling force was obtained, by which vessels of any magnitude might be drawn by a uniform mechanical force along any given distance. The forms of the models employed were not confined to mathematical and arbitrary solids, but were those of such classes of ships as are either actually employed in navigation, or have been proposed for that purpose. Among these were some of the highest reputation. It was found that there were other circumstances besides the form of the vessel which affected the result; and that the form and dimensions of the channel were as important as those of the vessel in determining it. Experiments had been instituted on the largest as well as the smallest scale, to show the law of relation between different scales. These various modes of experiment were illustrated by reference to drawings and tables which were prepared for publication. As an illustration of the value of giving a proper FORM to ships, altogether independently of proportion or dimension, the following remarkable experiments were adduced:—Four vessels, of about 25 ft. length, having all the same dimensions of breadth and depth, of the same capacity and weight, and of the same draught of water, were towed together at the same time, under the same circumstances, and at the same velocity. Some writers on naval architecture have asserted that, in such circumstances, vessels would have precisely the same resistance. The forms of these four vessels were not, to an inexperienced eye, very dissimilar: they were all good sea boats, and each of them found its admirers to give its shape a preference over the others. These vessels, alike in all their principal dimensions, and weight, and area of midship section, and draught of water, differed so much in resistance, that the one had nearly double resistance to another: thus, at 7⅛ miles an hour, the resistances were as follows:—

No. I. form	56·6	lb. resistance.
No. II. .. .. .. :	138·5	"
No. III.	102·7	"
No. IV.	90.2	"

All of these were good sea boats, and it was one of the most valuable of these results, that No. I., the form of least resistance, was found also the best sea boat, the easiest, and the driest. The whole of the observations, comprising more than 20,000, were in the course of preparation for publication, so that the whole body of the observations would be at the disposal of the Members of the Assocation. It had been the aim of the Committee to reduce the whole into the form most immediately conducive to the purposes of the naval constructor and mercantile ship-builder, and the drawings had been made on the scale and with the accuracy of the draughts of ships of the largest class.

Sir John Robison felt it his duty to state to the section, that although he had cordially given Mr. Scott Russell his co-operation in forwarding these experiments, and although Mr. Russell had made frequent use of the plural pronoun, yet that the whole of the merit, both of contriving and designing, and carrying out the system of experiment, was due exclusively to Mr. Russell.

Mr. Russell also explained a model showing the waves in a channel arising from the natural channel wave, and the wave resulting from the form of the boat.

Mr. Williams wished to know how Mr. Russell tested the horse power in the two boats which he had mentioned, as nominal power was not a fair test; and also whether he had paid attention to the difference in draught after the engines had been put in, the settling at stern or stem, &c., as the putting in the engine might make the vessel which had been slowest, when towed, fastest when driven by her own power—a vessel quick in slow water might be slow in a rapid current—in fact, every vessel had its own characteristic, and, therefore, many circumstances entered into the comparison between two vessels.—Mr. Russell said, that a reference to the report would show the steps which had been taken to insure accuracy. Of course in making experiments he had attended to all the circumstances which could introduce inaccuracy. In answer to Mr. Williams, he would say, that when the vessels were towed, the engines, stores, coals, &c. were exactly the same as when the engines were working; in fact, they had merely detached the tow rope and started the engines, and it so happened that the vessel which had been fastest in towing was also fastest in sailing with her own engines working, but he did not consider this as affecting the question.

Prof. Vignoles exhibited some specimens of newly invented carpet tapestry. He explained that these works were made on the principle of the ancient mosaics, being composed of innumerable transverse sections of woollen threads. No painting, no colouring was used; all the effect was produced by ends of worsted about ⅛ of an inch long standing vertically, one end being seen, and the other cemented by India rubber to a cloth. The exact operation was yet a secret, but he believed that two frames of fine wire or perforated zinc (some with even 4000 perforations in an inch) were placed over each other exactly vertically, the distance being only regulated by the height of the room, in the present instance he believed about five feet. The picture to be copied being then traced on the top side of the upper frame, a workman passed threads of dyed wool through the corresponding holes in the top and bottom frames, of course, as in tapestry, varying his shades and colours until he is satisfied with the effect; this he can judge of by looking down on the upper ends of the threads, although to a person looking at the space between the frames, there seems only a confused and compact mass of worsted. When the workman is satisfied, the upper ends of the threads are covered with India rubber cement, and a cloth is laid upon them also covered with cement; the ends of the threads firmly adhere to this cloth. By means of a sharp cutting instrument, the entire mass of threads is now cut through transversely at about ⅛ of an inch from the cloth, and this process being repeated, a fresh copy is obtained from every ⅛ of an inch: in the present frames, being five feet apart, 480 copies can be cut, and as there is no limit to the distance, except the height of the apartment, thousands of copies may be taken of each. Were this not the case, the invention, however ingenious, would be too expensive to be purchased except in solitary instances as specimens of curious art: but, from the facility of reproduction, this fabric was likely to come into general use for carpets, rugs, curtains, table and chair covers, &c.; for carpets and rugs it could be made with a longer nap, so as to give any degree of substance.

A Description of the Thames Tunnel. By Sir M. I. Brunel, F.R.S.

Sir M. I. Brunel exhibited a diagram of the exterior elevation of the Thames tunnel, and also a representation of the machinery by which he supported its roof and sides during the process of excavation. He said he had no paper to read, and that his work would be very short; for, although it might be very difficult to describe a work that was to be accomplished, there was little difficulty in speaking of that which had been completed. All he had to say was simply to point to the representation, and say, that the tunnel which he had erected was like that. The tunnel was about a quarter of a mile in length, and was made under the river Thames. The difficulties were very great, and deemed insurmountable by many learned and scientific men. Indeed, the difficulties were much greater than what he himself had at first conceived them to be; for the ground to be excavated was quite different from that which had been brought up with an augur in the preliminary examination of it. However, he was determined to persevere; and, notwithstanding the many obstacles that from time to time presented themselves, he never considered the undertaking impracticable. Sir M. I. Brunel then directed attention to the apparatus he had devised for sustaining the arch during the progress of the works. It was upwards of 60 ft. wide, by 22 ft. high, divided into 12 compartments, each containing three arches, one above another. The top was horizontal. Each compartment could be moved forward or backward at pleasure, so that, as the workmen excavated a few inches, the superincumbent pressure was immediately sustained by the protrusion of that part of the machinery opposite which the excavation was made. The ground was cleared away in front of each alternate division of the moveable arches, so that six were always stationary, sustaining the roof of the tunnel; while the other six were employed in making additional progress. Some of the strata overhead was quite dense, while part of it was in a fluid state. The workmen never advanced more than six inches at a time, and then the props were immediately introduced into the vacant place, and the building-up of buttresses and arches followed in the rear. During the progress of this extraordinary undertaking, five eruptions of the river had taken place. One of these occurred when the tunnel had been half done. This was in consequence of the men having struck for an advance of wages; and, during the delay which was thus occasioned, a very large hole opened in the top, and the water came pouring in. When this occurred, said Sir Mark, every one made a hole for his stopper; but he could get no one to make a stopper for the hole. By that unfortunate eruption, five men were lost. However, he succeeded in stopping the leakage, and in pushing forward the works, until he reached the other side of the river. After surmounting many difficulties, he had now the pleasure to come before the public for the first time, and say the work was done. Many had endeavoured to discourage him, and thwart the undertaking, but the Government were always exceedingly liberal; and the Duke of Wellington, from the first moment that he had seen the plan, conceived a high opinion of its practicability, and forwarded the undertaking as much as possible. A tower, 290 ft. in diameter, was erected at each side of the tunnel, and carriages could be admitted through them with the greatest ease. In answer to a question from Mr. Roberts, Sir M. I. Brunel said, that the quantity of water percolating at present through the tunnel was about 60 or 70 gallons per minute. About six weeks ago, 480 gallons oozed through; the quantity had since been reduced to about 60 or 70; and, in a short time, it would be reduced to nothing.

ON THE IMPROVEMENT OF THE SPECULA OF TELESCOPES. By Mr. Fox Talbot.

The subject occurred to him about two years ago, when the Earl of Rosse (then Lord Oxmantoun) was making much larger specula for reflecting telescopes, than had ever been obtained before; and he thought, if once we had a very large and perfect speculum, it might be possible to multiply copies of it by means of the electrotype—by galvanic means taking an electrotype cast from the existing original at a small expense—which, if not quite so perfect as the original, should be at least very fine and important instruments. He had observed, that if an electrotype cast were taken from a perfectly polished surface, the cast was also perfectly polished; so that no defect of form from this cause could have an injurious effect on the speculum. The great and obvious defect was, that electrotypes being in copper, which reflected but little light, a very large speculum of copper would not reflect more light than a very small one in speculum metal. He mentioned these ideas to Professor Wheatstone, who said the same had occurred to him, and he showed him a paper which he had drawn up some few months before, and which he lent him.

Mr. Talbot read this paper of Professor Wheatstone's, in which he suggested the taking galvano-plastic casts of specula in platina, palladium, silver, or nickel, and for especial purposes gilding the copper; taking care that the two precipitations adhered well to each other. He suggested that voltaic electricity might thus enable us to copy large specula (like those of Lord Oxmantoun), at a slight expense. So that (said Mr. Talbot) the idea had suggested itself independently to both of them; but on comparing notes they found differences. Though it had occurred to him (Mr. Talbot) to precipitate white metals, yet he did not think that platina would have a sufficiently beautiful white metallic polish. Silver he rejected, because easily oxidated by the atmosphere. Nickel he had not tried, but it appeared likely to answer. Professor Wheatstone had, however, made choice of platina, and varying the quantity till he found the required proportion, he obtained a mirror in platina which appeared to him (Mr. Talbot) to have quite brilliant polish enough, and to be white enough to answer the purpose; and he considered, therefore, that Professor Wheatstone had proved that, at least in one form, the specula of telescopes might be made by voltaic precipitation. His own idea was, that it might be possible to whiten the surface of the copper without injuring the form; and, therefore, having obtained a speculum in very bright polished copper, he exposed it to the vapour of the hydro-sulphuret of ammonia, which had the property of turning copper white; and it did so without, so far as he knew, in the least injuring the form of the metal. A copper speculum was subject two evils; it reflected but little light, and it became easily tarnished; but, when whitened by exposure to the hydro-sulphuret of ammonia, the surface was transformed into a sulphuret of copper, and not only was a white metal obtained, but it was no longer subject to be tarnished by the atmosphere, the sulphuret of copper being a stronger chemical compound than the oxide of copper, and, consequently, oxygen had no more effect upon it than on platina. Having obtained a copper cast from a polished speculum, he, (Mr. Talbot) whitened it, and transformed it into sulphuret of copper; and, after having retained it about a year, he did not perceive the smallest alteration in any respect. This, therefore, appeared to him a mode by which such important results for astronomers could be obtained. For the last year, perhaps, nothing farther had been done, either by Professor Wheatstone or himself; but the other day, being at Munich, he (Mr. Talbot) visited Professor Steinheil, who showed him his inventions, and told him he had invented a method of making specula by the electrotype. It so happened, that both Professor Steinheil and himself had published their respective methods about a month or six weeks before, the Professor having read a communication on the subject before the Academy of Sciences at Munich, and printed it, and he (Mr. Talbot) having published his in England. Their modes were, however, different, as Professor Steinheil precipitated gold upon the speculum of copper; and, having precipitated a certain thickness of gold, he then precipitated copper on the back of the gold, to give it sufficient thickness. He (Mr. Talbot) should have thought beforehand that gold would not reflect light enough to be available; but Professor Steinheil informed him he had found, by careful experiment, that it reflected more light than polished steel. He allowed Mr. Talbot to look through a Gregorian reflecting telescope, of which the speculum was a common one, but gilded, and he found the image perfectly clear and well-defined. A slight tinge of yellow was thrown over all the objects, but the image was perfectly clear and defined. Now it was evident, that if the form of the speculum was not destroyed by gilding it, much less would it be altered if formed originally of gold. If a film of gold were precipitated upon a speculum of copper, we must, to a certain extent, alter its figure; but that alteration must be very small, because there was no perceptible defect in the image. Professor Steinheil said, that the astronomers of Germany were much pleased with his plan, and were greatly engaged in the subject; and that in the course of a year he should have a very large telescope, furnished not only with a speculum, but also with other apparatus, voltaically formed, so that telescopes might be made all from a good model, so as to insure greater accuracy of proportions; and in this way even very large telescopes might be constructed at a comparatively trifling expense. With reference to the precipitating copper on the back of the gold, the Professor had a simple expedient for securing adhesion. He first precipitated gold from the cyanide of gold, and he mixed with it cyanide of copper, and kept gradually increasing the quantity of the latter sort; so that an alloy was precipitated which was continually increasing the copper with respect to the gold, till he had a speculum whose surface was gold, and which then became an alloy, the quality decreasing, till, at the bottom, it became pure copper. This was important, because, without such experiments, one would not have known that such results would have followed; for some philosophers supposed that, if we attempt to precipitate the salts of two metals, only one was precipitated; but Professor Steinheil informed him that they precipitated in union. He thus obtained a speculum with a face of gold and a back of copper. But, supposing the largest, cheapest, and best speculum were obtained, the framework of the telescope would be so gigantic, that few observers would be able to use the instrument. With a focal length of 60 to 80 ft., it would be quite unmanageable for any private individual. The idea occurred to him (Mr. Talbot) to have a tube fixed in an invariable position, and to have a perfectly true plane mirror, of a size somewhat larger than the concave speculum, placed in front of the tube, with an aperture in the centre. This plane reflector should be moveable about its centre in any direction; so that luminous bodies, falling first upon the plane reflector, were then reflected against the concave reflector, and passed through the aperture. The only motion requisite for the plane mirror would be one about its centre. The mechanical difficulties in the way of this plan would be far less than in the common method. Professor Steinheil's idea on this point was somewhat different. He (Mr. Talbot) did not think it important in what direction the tube of the telescope was directed. Professor Steinheil's idea was, that it should be pointed directly to the pole of the heavens, and kept as steady as possible, and that the plane mirror should have a simple motion of revolution, indeed two motions, but about a rectangular centre.

Remarks.—Sir William Hamilton expressed his pleasure at hearing this communication, and said, the want of some such contrivance as the last had become sensible to those having great command of money and power. The Earl of Rosse had lately cast a metal speculum, weighing several tons, and six feet in diameter, which his lordship intended should be moveable only in or very near the meridian, on account of the great mechanical difficulty of moving so great a mass, so as to direct it at pleasure to every point of the heavens. The advantages, therefore, would be great from carrying out the plan last mentioned. It was clear, that its success and utility must depend greatly on the excellence of the original. Lord Rosse had, hitherto, been unrivalled for making specula on a large scale, and for his means of carrying forward this magnification of the mirror to an unparalleled extent; and perhaps the degree of acquaintance with which that nobleman had honoured him, and the recollection of what Dr. Robinson had recently said in his lordship's name, warranted him (Sir William) in saying, that Lord Rosse was disposed to give every facility to persons of science, desirous to make use of his instruments.

Mr. Isaac Holden said, the late Earl of Stanhope had invented and erected a telescope on the plan (as to the fixity of the frame-work) which Mr. Talbot recommended. The instrument was stationary, and he could sit still and view more than one-half the heavens, taking in even 20° behind his head, by means of an arrangement of mirrors.

Sir D. Brewster mentioned a similar plan, proposed twenty years ago, by an American gentleman, to the Royal Society of Edinburgh. There the mirror was not vertical like Lord Stanhope's, but horizontal, consisting of a dish of metal in which a quantity of mercury was placed, and a rotatory motion was given to the disc, so that the mirror assumed a concave form, giving a parabolic surface, of the actual form required to reflect bodies; by which means a mirror was constructed in one instant of time. This appeared so impracticable to that society, that they did not venture to give any account of it in their memoirs.

PHOTOGRAPHIC DISCOVERIES.

Sir David Brewster said, he was requested to communicate an account of some remarkable facts connected with the theory of photography. A new process of producing photographic impressions had been discovered by Dr. Moser, of Königsberg; and an account of the discovery had been brought to this country by Professor Bessel, who received it from the discoverer himself. The subject was most important, and it would have been a great misfortune if the physical section had left without having been made acquainted with it. The following were the general facts connected with it:—A black plate of horn, or agate, is placed below a polished surface of silver, at the distance of one-twentieth of an inch, and remains there for ten minutes. The surface of the silver receives an impression of the figures, writing, or crest, which may be cut upon the agate, or horn. The figures, &c. do not appear on the silver at the expiration of the ten minutes, but are rendered visible by exposing the silver plate to vapour, either of amber, water, mercury, or any other fluid. He (Sir David Brewster) had heard Professor Bessel say, that the vapours of different fluids were analogous to the different coloured rays of the spectum; that the different fluids had different effects, corresponding to those of the spectrum; and that they could, in consequence of such correspondence, produce a red, blue, or violet colour. The image of the *cameo obscura* might be projected on any surface—glass, silver, or the smooth leather cover of the book—without any previous preparation; and the effects would be the same as those produced on a silver plate covered with iodine. Professor Bessel did not pretend that this discovery was perfect. He also mentioned what was far more important than all this, in a scientific point of view—that Professor Moser had discovered the existence of latent light—of light residing in bodies, and exhibiting its action after having lain in those bodies for we know not how many years. If it were an actual physical fact that latent light did exist—if light took its residence permanently in a body—if, having motion, it stood still, and did not shine—if it did not trouble the ether in any way, was its motion extinguished? and, if so, how was it to be put in motion again? This idea of latent light corresponded with Newton's opinion, that light entered the surface of charcoal, and never was brought out again; but Moser had discovered a mode of bringing it out again.

Sir William Hamilton: "Have you any account that he has discovered the fact?"—Sir David Brewster: "He conceives he can prove the existence of latent light."

Professor Bessell said, he scarcely had time to obtain from Professor Moser all the particulars of his discovery; but he (Professor Bessel) had seen a plate of silver representing the image on a black agate cameo. This photographic image was very good, and looked as well as any of those likenesses taken by Talbot or Daguerre. Professor Moser said he had produced those likenesses even at midnight, without using any light. The exclusion of light made no difference whatever in the phenomena.

Sir David Brewster thought the image thus produced might have been as perfect probably as the first specimens of daguerreotype. He had alluded to charcoal absorbing the rays of light—there was another analogous phenomenon; if a tube were filled with nitrous acid gas, and rays of light passed through it by a lens, the fluid would almost lose its yellow colour, and become so white, that every object might be seen through it; but if it were exposed to a higher temperature, it became gradually yellow, then orange, and at length it would become of such a deep red colour, that the light of the meridian sun could not pass through it—the gaseous body standing like a column of charcoal before the spectator. By allowing the gas to cool down, it gradually becomes transparent, passing backward through the same steps. The opacity arises from the heat; and, if there be such a thing as latent light, it must have acted on the particles of the gas.

On the Pressure of Earth against Walls. By C. W. Buck, C. E.

Mr. Buck thought it desirable to investigate the resistance offered by earth to displacement, when a rigid vertical plane is thrust against it—as where abutments of bridges are made, for economy, to depend for stability on the resistance of the earth behind them. In cases of this sort, the tendency of the pressure is manifestly to cause a rupture of the earth, and force a wedge of it upwards; and it is curious to observe that the angle at which this rupture takes place (the angle of least resistance) is the same as that given for the maximum thrust by Provy—that is, half the complement of the angle of repose. To estimate the horizontal thrust against the wall below the spring of the arch, when this arch is sprung from the top of the wall, and when the entire height behind the wall is filled up with earth to the level of the top of the roof of the arch, there are two masses of earth to be considered:—1st. The wedge of earth acting against that portion from the top of the wall up to the top of the arch; and, 2nd, The quadrilateral figure left when this wedge was subtracted from the entire wedge from the foot of the wall to the top. It is the horizontal thrust of this latter portion which is to be considered; and this horizontal thrust is equal to the horizontal thrust of the entire wedge *minus* the horizontal thrust of the wedge above the top of the wall *minus* the friction of the base or line of rupture of this latter wedge. This can be found easily for any particular case; but it is also desirable to find the proper height from which to spring the arch, so that the friction of the lines of rupture of the two wedges shall neutralize the horizontal thrust against the wall below the arch. This is found to be when the distance from the level of the roof of the arch to the top of the wall is equal to the entire depth, from the top of arch to the foot of wall, multiplied by the square root of the tangent of angle of maximum thrust. Following out this result for fluids, where the friction is *nothing*, the arch should spring from the bottom of the wall; and this Mr. Buck called the "Tunnelling Equation," because it shows what thickness of roof is sufficient to neutralize the pressure of the sides, and points out how far it is necessary to cut the ground open, curb it, and cover it again when there is not sufficient thickness of roof for ordinary tunnelling. It shows, also, how strong to make the side walls, and what form to give them to resist the lateral thrust. The investigation further proved the danger of the common practice in sinking shafts, of sinking to a considerable depth before curbing, or securing with brick-work, from the supposition that the earth must needs stand of itself; and, therefore, that it will answer as well to begin the curbing at some inferior point; whereas the reverse is true—that if the top be well secured, the part below will not move. These remarks, however, are based on the supposition that the earth is homogeneous. Mr. Buck was proceeding to read over the mathematical formulæ of his investigation, when—

The President thought the subject was too analytical to be interesting to the Section.—Professor Moseley stated that Poncelet had lately investigated all the conditions of subjects taken up in Mr. Buck's paper, and given formulæ and tables for their application, by practical men, except the one for tunnelling. Poncelet's paper was published in the Memoirs of the Academy.

Sir Mark J. Brunel thought it dangerous for engineers to place reliance upon formulæ which applied only to homogeneous ground. In the Thames Tunnel he had found ten or twelve different strata in a depth of eight feet; and, from the constant fluctuation of the weight above, and the fluid portion of some part of the ground, theoretical inquiries would have been useless in determining the manner of his proceeding.—Mr. Buck observed, in answer, that even in the case of fluid ground, theory assisted in determining the resistance necessary. Taking the London clay as an example, the friction in the line of maximum thrust was $\frac{7}{10}$ of the weight; and by comparing the specific gravity of this clay with water, he found that where, by the infiltration of water, this friction was reduced to $\frac{3}{10}$, the pressure was equal to hydraulic pressure, and when the friction was reduced to 0, it was double hydraulic pressure.

Sir John Robison made a short communication on the subject of *a mode of making tesselated tiles and other objects by the compression of dry powder of clay, by Messrs. Minton & Co., of Sroke-upon-Trent.* Sir John stated, that the advantages of the invention were the perfect truth of the tiles. When formed of wet clay, they almost invariably warped and became crooked. In this invention, a mould was filled with the dry powdered clay, which was subjected to heavy pressure, which caused it to cohere sufficiently to bear being placed in the kiln, where it was burned in the usual manner. Some specimens of tesselated tiles, and also of roofing tiles of a new construction, much lighter than ordinary tiles, and by which the capillary action of water, under the edges of the tiles, was prevented, were exhibited. The tiles were exceedingly accurate in point of form, and appeared extremely well adapted for the purposes for which they were intended.

Mr. Brockedon exhibited specimens of his *patent India rubber stoppers for bottles*, explaining the late improvements in the construction of the cores on which the India rubber is spread. The present cores, he said, were made of cotton twisted into strands, &c., by means of a machine, which he explained by a diagram, the cylindrical rope now consisted of several strands of tightly twisted cotton, lapped with flax thread, and laid together longitudinally, loose fine cotton rovings being placed between them; the entire was then lapped in a cylindrical form with flax thread, attaining by this method the advantages of perfect roundness and firmness; they also gave sufficient hold to the corkscrew, and bore the heating process well. These stoppers would slide on glass when wet, but not when dry, (although there was no cohesion in this latter state,) so that the bottler, by slightly wetting these stoppers with the liquor which he was bottling, could easily insert them; and when this slight film of moisture mas dried up, the stopper required considerable force to withdraw it.

Mr. Louis Schwabe made a short communication *on the formation of artificial threads of glass*, for the manufacture of ornamental damasks, some very beautiful samples of which he exhibited to the section. Mr. Schwabe stated, that he had tried various kinds of glass, and found that that which was best adapted to the purpose was common window glass; the samples before the meeting having been made from the broken windows of his own establishment. There was one peculiarity in the matter which was worthy of remark, that the minute fibres of glass drawn from the lamp were always of the same shape as the bar of glass from which they were drawn. If that was round, the thread was round, if square or flat, the form of the thread varied accordingly; and, as a flat thread reflected the light better, and con-creasing the depth, if possible, this is the point to be attended to. It thus appears that a weight of 36 lb. per yard is required to sustain the engine, and all beyond will belong to the mode of attaching the rail to the support below.

In treating of the wear and tear of rails, Mr. Nicholas Wood has given some curious and interesting results of experience; but the weight of the locomotive engines used is stated to have been only 10 tons, and of this the weight on the driving-wheels would probably not exceed six or seven tons. The result of a variety of experiments on the malleable iron rails of the Stockton and Darlington Railway gave one-tenth of a pound per yard as the absolute amount of fair abrasion; some statements, however, made it much higher, being one-sixth of a pound. On the Killingworth Colliery it was one-eighth of a pound. On the Liverpool and Manchester Railway, some years ago, three rails were taken up, carefully cleaned and weighed, relaid, and taken up again at the end of one, and again at the end of two years: the wear was found constant, and about one-tenth of a pound per yard per annum. If we were to take this to be the true wear, and suppose it to arise wholly on the upper surface of the rail, the result would be but the 84th part of an inch in depth, and it might be supposed to take 100 years to wear away a rail from mere abrasion. But later experience shows that the increased weight of engines acts very destructively on rails whose upper webs are not sufficiently strong, and of the best manufacture. We may take 10 tons as the present average weight on the driving-wheels of a locomotive engine; and, if this is to be effectually provided for, the button, or bearing part of the rail, must not be less than 40 lb. to the yard. Now the form of the remaining part of the rail will depend upon the manner in which it is to be fastened down to the support below, either by being fixed in a chair, which is itself to be again fastened to something else, or by being screwed down, as the rails on the Great Western, Croydon, and the new part of the Greenwich Railway; or, finally, secured in the simple manner described in the last lecture. A comparatively very small addition to the theoretical form of rail to be sustained in a chair, gives a section which has the advantage of being capable of being turned in either direction, or vertical position, and hence the top and bottom of the rails have, of late, as previously stated, been made equal and similar, connected by a neck of proportionate dimensions. With the present heavy rails, of nearly 80 lb. to the yard, the average weight of the chairs, including the joint chairs, may be taken at 20 lb. per yard, reducing the intervals of support to that constant distance. Thus, we have an aggregate of nearly 100 lb. weight of iron per yard of each single rail. If, then, we could in any way get rid of the extra weight required to fasten the rail into the chair, and dispense with the chair altogether, it seemed to Mr. Vignoles to be desirable to do so, provided the object in view was equally well attained; and he contended that such would be the case with a 50 lb. rail attached, in the mode before described, to a longitudinal bearing of timber; for the whole strength of the upper or bearing part would be retained, that being as the breadth and the square of the depth; thus, with a weight of iron just one-half, would be equally efficacious, and it only remained to compare the supports in either case. Now, as stone blocks seemed to be discarded by universal consent, the question of the supports below is narrowed to that of *transverse* or of *longitudinal* wood sleepers. Sufficient experience had been obtained to warrant the conclusion that, for the purposes of this argument, the cost of fastening and of laying the rails, ballasting, drains, &c., taken as a whole, were nearly the same for both systems, and it only remained to contrast the quantities of timber, and, always considering a locomotive line to be the one to be made, it may be stated that this cubing was about double for the longitudinal system to that in the transverse method of laying the sleepers. In short, looking at first cost only, there was a saving of 100 lb. of iron, and an increase of two cubic feet of timber in each yard of single trackway of the former over the latter mode, so that strictly the longitudinal system was the cheapest; but to avoid minor objections, let the cost of each be taken to be the same, which was giving a decided concession in favour of the transverse system. But this was a very narrow view to take of the question, which wholly omitted the economical results from diminished wear and tear of the engines, of the railway, and of the carriages, as had been most especially exemplified on the Dublin and Kingstown Railway, where the massy granite blocks originally laid down had been all replaced by longitudinal sleepers, and though the old light 45 lb. rails and 15 lb. chairs were retained, the diminution of the annual maintenance was most remarkable, though there was not a railway in the United Kingdom where so many passengers were carried daily throughout the year.

The expense of keeping up the double way, now that the system of longitudinal timbers has been quite carried out, is less than one-third of the corresponding expense per mile per annum of maintaining the London and Birmingham Railway. Mr. Vignoles then read a variety of tabular results of the cost of the three various systems, going through all the details, and pointing out the exact measures and quantities, and stating the actual expenditure on the upper works of various lines of railway. The result seemed bed of the road was duly prepared, including all the items under that that, for a double line of railway—upper-works, properly laid after the head, which were enumerated in a former lecture, and calculating, for the present heavy and powerful locomotive engine, that no less a sum than £5000, and, in most cases, £6000, per mile was necessary, and that, in many instances, it had reached nearly £7000—the market price of iron and timber, also the quality of the latter, the greater or less facility of obtaining materials for ballast, &c., affecting the amount, and these large sums were independent of the earthwork, masonry, land, fencing, management, stations, carrying establishment, &c. Mr. Vignoles also gave a number of drawings and diagrams contrasting the three systems, and exhibiting, in a very explanatory manner, the modes of laying and fastening. He also exhibited the rail, chair, and fastenings, for the transverse method, with all the recent improvements introduced by Mr. Cubitt on the South-Eastern Railway, and as manufactured by Messrs. May, of Ipswich, and then produced the rail with the dove-tailed slot, and the mode of attachment to longitudinal half baulks of timber, repeatedly alluded to in this and the preceding lecture, observing forcibly, that, if the same effective results were obtainable by the latter simple method as by the former complicated one, it was not only to be preferred in this kingdom, but was peculiarly eligible for such countries as Russia, Poland, Germany, in general, France, and America, where wood is usually in great abundance, and where iron is comparatively scarce, especially in the form required for railway bars, and, of course, the prices became in proportion. Mr. Vignoles quoted largely from the works and reports of Tredgold, Barlow, and Lecount, and stated a number of mathematical and empirical rules laid down by those authors, which, he stated, were chiefly relating to rails supported at intervals, but, though he felt it right to lay them before the class, he considered that farther experiments and investigations were requisite, and particularly in reference to the perfect combination in one support of the iron and timber in the longitudinal system, as explained and avocated by him, of which the Professor insisted, the great advantage and peculiarity was that of obtaining a perfect fastening, independent of the fibre of the wood, or the tenacity of the screws or bolts therein, and of obviating the hitherto well-founded objections to the mode of attaching rails having a continuous bearing, which had not been able to prevent a vertical play of the iron on the timber.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

TWELFTH MEETING, 1842.—*Held at Manchester.*

(Continued from page 277.)

REPORT ON EXPERIMENTS ON THE TRANSVERSE STRENGTH OF HOT AND COLD BLAST IRON. By Mr. Fairbairn.

THE bars, as described in the former reports, were supported by standards, 4 ft. 6 in. apart, and were loaded with different weights; they were occasionally carefully examined, and showed a very slight progressive deflection. He had no doubt that they would ultimately break, but the progress was very slow. He read a table showing the weights laid on, and the deflections of each bar.—Mr. Hartopp said, that Mr. Fairbairn's former experiments on hot and cold blast iron had created a false impression with regard to the strength of hot blast iron. Mr. Fairbairn had found very little difference between the hot and cold blast; but his experiments, made with great accuracy, and in which the weights were laid on with great care, were of little practical advantage, as these were not the circumstances under which iron was tested in practice: there percussion, violent and sudden impact, should be expected, and here lay the great deficiency of hot blast iron. Even in Mr. Fairbairn's experiments, Oldberry No. 2, cold blast, bore twice the percussion of Oldberry hot blast; and Milton hot blast was only half the strength of Elsicar cold blast, made of the same ore and smelted with the same coal. Experiments had been made in Yorkshire with great care; the results being, Low Moor cold blast bar iron, 3 in. diameter, broke with 6 blows, ditto Scrap, 3 blows, ditto hot blast, 1 blow; again, Low Moor cold blast 18 blows, Bierly ditto, 18, hot blast of as good materials, 3 blows; again, Elsicar cold blast, 21 blows, Milton hot blast, 1½ blow; therefore, in iron for axles this difference of at least five-sixths of the strength was very important. As to scrap iron, it bore too high a character. Scrap, made on the old plan, was all charcoal iron, but the modern scrap iron was very inferior, being 32*s*. 6*d*. per ton cheaper, so that ironmasters put off as much of this cheap material as possible. Hot blast iron was rejected now for water-pipes, &c., and even for cannon balls; and, in fine, he had been told by very eminent marine engine makers, that where any percussion took place, hot blast cast iron was only half the strength, and wrought iron only one-sixth the strength of cold blast.

Mr. Fairbairn explained, that he had found great difficulty in obtaining specimens from the different iron-masters, who would of course send, when possible, the best specimens, but every care had been taken to insure accuracy in the experiments.

Mr. Hodgkinson said that the average strength of hot blast had been $\frac{3}{100}$ weaker than the cold, but the inferiority was chiefly in the softer irons; as the hardness increased, the two kinds approached to equality, and in the hardest irons the hot blast was the best. He thought his experiments, made without any interest on either side, and with the greatest care, were more to be depended on than experiments made by those who had an interest in the result.

Professor Vignoles explained, that the question of hot and cold blast had nothing to do with the late contract for cannon balls.

On the Form of Ships.

Mr. Scott Russell laid on the table the *Report of a Committee on the Form of Ships.* It contained upwards of 20,000 observations, the result of careful experiments on the resistance to models of ships of more than a hundred different forms and sizes, and extending from small models of 30 in. long, to vessels of 25 ft., 60 ft., and 200 ft. long, and above 1000 tons burden. These experiments were under the general superintendence of a Committee of the Association, consisting originally of Sir John Robison, Mr. Scott Russell, and Mr. Smith. Unfortunately, the ill health of Mr. Smith's family had altogether deprived the committee of his advice and asssistance, but the observations were personally conducted by Mr. Scott Russell, who had to acknowledge the pleasure he had derived from conferring with his friend Sir John Robison, with whom he had frequent occasion to consult during the progress of the observations. The smaller experiments had been made in a reservoir in the ground attached to his (Mr. Russell's) residence, and the larger ones in the open sea. It was probable that these results, maturely digested, and illustrated by accurate drafts of the forms of the ships subjected to experiment, would be published in such completeness as might be practically serviceable to the naval constructor and mercantile ship-builder; and he would, therefore, confine the present report to a general account of the objects contemplated in the experiments, and the method by which these designs had been carried out. Several series of experiments have already been made, both by scientific bodies, and by public-spirited men, for the advancement of naval architecture. These had cost large sums of money, and consumed much valuable time and talent. To most of them it had been objected—unhappily not without reason—first, that they had not been conducted with an adequate knowledge of the wants of the constructor; secondly, that the forms of bodies submitted to experiment were by no means such as are used by the ship-builder; thirdly, that the scale on which these bodies were constructed was too small to claim for the results, as applied on a large scale, any considerable degree of confidence; fourthly, that it had not been established by what law the results of experiments on one scale of magnitude are to be transferred to a different scale, either greater or less; and, fifthly that the apparatus formerly used was liable to errors which it was difficult to eliminate from the results. To obviate such objections was one great object in these experiments. Mr. Russell had contrived a new apparatus, which was so simple and convenient, that a uniform propelling force was obtained, by which vessels of any magnitude might be drawn by a uniform mechanical force along any given distance. The forms of the models employed were not confined to mathematical and arbitrary solids, but were those of such classes of ships as are either actually employed in navigation, or have been proposed for that purpose. Among these were some of the highest reputation. It was found that there were other circumstances besides the form of the vessel which affected the result; and that the form and dimensions of the channel were as important as those of the vessel in determining it. Experiments had been instituted on the largest as well as the smallest scale, to show the law of relation between different scales. These various modes of experiment were illustrated by reference to drawings and tables which were prepared for publication. As an illustration of the value of giving a proper FORM to ships, altogether independently of proportion or dimension, the following remarkable experiments were adduced:—Four vessels, of about 25 ft. length, having all the same dimensions of breadth and depth, of the same capacity and weight, and of the same draught of water, were towed together at the same time, under the same circumstances, and at the same velocity. Some writers on naval architecture have asserted that, in such circumstances, vessels would have precisely the same resistance. The forms of these four vessels were not, to an inexperienced eye, very dissimilar: they were all good sea boats, and each of them found its admirers to give its shape a preference over the others. These vessels, alike in all their principal dimensions, and weight, and area of midship section, and draught of water, differed so much in resistance, that the one had nearly double resistance to another: thus, at 7½ miles an hour, the resistances were as follows:—

No. I. form	56·6	lb. resistance.
No. II.	138·5	„
No. III.	102·7	„
No. IV.	90.2	„

All of these were good sea boats, and it was one of the most valuable of these results, that No. I., the form of least resistance, was found also the best sea boat, the easiest, and the driest. The whole of the observations, comprising more than 20,000, were in the course of preparation for publication, so that the whole body of the observations would be at the disposal of the Members of the Assocation. It had been the aim of the Committee to reduce the whole into the form most immediately conducive to the purposes of the naval constructor and mercantile ship-builder, and the drawings had been made on the scale and with the accuracy of the draughts of ships of the largest class.

Sir John Robison felt it his duty to state to the section, that although he had cordially given Mr. Scott Russell his co-operation in forwarding these experiments, and although Mr. Russell had made frequent use of the plural pronoun, yet that the whole of the merit, both of contriving and designing, and carrying out the system of experiment, was due exclusively to Mr. Russell.

Mr. Russell also explained a model showing the waves in a channel arising from the natural channel wave, and the wave resulting from the form of the boat.

Mr. Williams wished to know how Mr. Russell tested the horse power in the two boats which he had mentioned, as nominal power was not a fair test; and also whether he had paid attention to the difference in draught after the engines had been put in, the settling at stern or stem, &c., as the putting in the engine might make the vessel which had been slowest, when towed, fastest when driven by her own power—a vessel quick in slow water might be slow in a rapid current—in fact, every vessel had its own characteristic, and, therefore, many circumstances entered into the comparison between two vessels.—Mr. Russell said, that a reference to the report would show the steps which had been taken to insure accuracy. Of course in making experiments he had attended to all the circumstances which could introduce inaccuracy. In answer to Mr. Williams, he would say, that when the vessels were towed, the engines, stores, coals, &c. were exactly the same as when the engines were working; in fact, they had merely detached the tow rope and started the engines, and it so happened that the vessel which had been fastest in towing was also fastest in sailing with her own engines working, but he did not consider this as affecting the question.

Prof. Vignoles exhibited some specimens of newly invented carpet tapestry. He explained that these works were made on the principle of the ancient mosaics, being composed of innumerable transverse sections of woollen threads. No painting, no colouring was used; all the effect was produced by ends of worsted about $\frac{1}{8}$ of an inch long standing vertically, one end being seen, and the other cemented by India rubber to a cloth. The exact operation was yet a secret, but he believed that two frames of fine wire or perforated zinc (some with even 4000 perforations in an inch) were placed over each other exactly vertically, the distance being only regulated by the height of the room, in the present instance he believed about five feet. The picture to be copied being then traced on the top side of the upper frame, a workman passed threads of dyed wool through the corresponding holes in the top and bottom frames, of course, as in tapestry, varying his shades and colours until he is satisfied with the effect; this he can judge of by looking down on the upper ends of the threads, although to a person looking at the space between the frames, there seems only a confused and compact mass of worsted. When the workman is satisfied, the upper ends of the threads are covered with India rubber cement, and a cloth is laid upon them also covered with cement; the ends of the threads firmly adhere to this cloth. By means of a sharp cutting instrument, the entire mass of threads is now cut through transversely at about $\frac{1}{8}$ of an inch from the cloth, and this process being repeated, a fresh copy is obtained from every $\frac{1}{8}$ of an inch: in the present frames, being five feet apart, 480 copies can be cut, and as there is no limit to the distance, except the height of the apartment, thousands of copies may be taken of each. Were this not the case, the invention, however ingenious, would be too expensive to be purchased except in solitary instances as specimens of curious art: but, from the facility of reproduction, this fabric was likely to come into general use for carpets, rugs, curtains, table and chair covers, &c.; for carpets and rugs it could be made with a longer nap, so as to give any degree of substance.

A Description of the Thames Tunnel. By Sir M. I. Brunel, F.R.S.

Sir M. I. Brunel exhibited a diagram of the exterior elevation of the Thames tunnel, and also a representation of the machinery by which he supported its roof and sides during the process of excavation. He said he had no paper to read, and that his work would be very short; for, although it might be very difficult to describe a work that was to be accomplished, there was little difficulty in speaking of that which had been completed. All he had to say was simply to point to the representation, and say, that the tunnel which he had erected was like that. The tunnel was about a quarter of a mile in length, and was made under the river Thames. The difficulties were very great, and deemed insurmountable by many learned and scientific men. Indeed, the difficulties were much greater than what he himself had at first conceived them to be; for the ground to be excavated was quite different from that which had been brought up with an augur in the preliminary examination of it. However, he was determined to persevere; and, notwithstanding the many obstacles that from time to time presented themselves, he never considered the undertaking impracticable. Sir M. I. Brunel then directed attention to the apparatus he had devised for sustaining the arch during the progress of the works. It was upwards of 60 ft. wide, by 22 ft. high, divided into 12 compartments, each containing three arches, one above another. The top was horizontal. Each compart-

Mr. Bull stated that the banks of the river Calder in Yorkshire had been effectually secured from damage by means of stone pitching or setting, laid at an angle of from 45° to 50° with the horizon, and resting on a mass of stone thrown into the bed of the river below the level of the water in dry seasons. These loose stones had generally been laid at an inclination of about 25° or 30° where the depth at low-water was not great, but where the water was deep the lower part of the slope had been made at about 45°, returning at the upper part or near the surface of the water to the former angle of 25° to 30°. The pitching, composed of oblong stones, was laid in courses, with nearly vertical joints, having the least sectional area exposed to the action of the flood-waters. The stones were from 15 to 20 inches long, varying in their widths, and were laid on a bed of gravel, or soil, he preferred coarse gravel, as it was less liable to be washed out from behind the stones, which sometimes occurred with soil, unless it was of a strong clayey nature. Several miles of facing done by him in this manner had now been standing between seven and nine years without requiring any repairs. In a few instances, when the loose stones at the foot had been either insufficient in quantity, or so small as not to resist the action of the floods, and had been washed away, the pitching has slid down into the bed of the river without being otherwise disturbed; after it had settled, the top part had been renewed, and the original line restored. The floods in the river Calder frequently rose from 8 ft. to 12 ft., and flowed with a very rapid current, consequently the pitching had to resist a powerful action, particularly at the concave side of a bend in the river, where the action was both directly upon and along the face of the work. The loose stones below the low-water mark were seldom disturbed by the floods, and where they had been removed, no damage had been sustained beyond the sliding down of the pitching as before described; such, however, had not been the case where from peculiar circumstances a perpendicular or nearly perpendicular wall had been built instead of the pitching; in such instances a slight disturbance of the loose stones had frequently caused the destruction of the wall. Where the pitching had been backed with light soil, which was easily washed out through the joints, the stone-work had fallen into holes as might be expected, but where a good strong gravel had been used for the backing, no such instances had occurred. Mr. Bull differed from Colonel Jones's opinion as to breakwaters with a vertical or nearly vertical face, beause any disturbance of the footing, however slight, must have a tendency to overthrow the wall, and that tendency would be in proportion as the angle of the wall diverged from the angle of repose; that is to say, if the wall was quite perpendicular a comparatively small disturbance of the foundation or footing would destroy the equilibrium, and the superstructure would be overthrown, but the nearer the face approached the angle of repose, the greater would be the security. He did not mean to assert that the angle of repose was the best for the face of a breakwater, or that the same angle should be preserved from below low-water mark to the top of the structure. On the contrary, he was inclined to think that a curved section, commencing from a few feet below low-water mark at an angle of 10° or 15° from the horizon, and terminating at the top at an angle of 70° or 75° would be found a good form, and if the courses of face stones were laid nearly vertically, should the footing below low-water mark be removed by the action of the waves, the consequence would be a sliding down of the upper face, which could easily be replaced at the top, as is done with respect to the river pitching. The proper angle for the loose stones below low-water mark would, he had little doubt, be that of repose, or nearly so, as Colonel Jones had shown to be the case in several existing breakwaters. The face stones should be roughly squared on the beds and joints, or what is called in the North "scappled" to the form of the curve, and laid in equal courses not quite perpendicular, but inclining a little from the direction of the prevailing wind, perhaps about 10° from the vertical line. Mr. Bull was induced to offer these remarks, for the purpose of recording a practice he had successfully applied to the protection of river banks (of which he presented drawings) and his opinion as to its applicability to the construction of breakwaters.

April 19.—The President in the Chair.

Flushing Apparatus for Sewers.

"*On the causes of accumulation of deposit in Sewers, and on the hitherto generally prevalent mode of removing the same; with a description of a new Flushing Apparatus used for cleansing the Sewers in the Holborn and Finsbury Divisions.*" By John Roe, Assoc. Inst. C. E.

In the Holborn and Finsbury Divisions there are upwards of 80 miles of covered sewers, in a large proportion of which there were accumulations of deposit, which, by choking the side drains and causing effluvia, became sources of much annoyance. The only remedy resorted to, was to raise the deposit to the surface of the street and cart it away: this was for many reasons an objectionable process, and a careful examination of the sewers was ordered, when it was found that many causes of obstruction existed. In sewers of the same form and inclination, different degrees of accumulation existed: this was caused sometimes by a greater run of water in one than in the other. In other cases, although the flow of water was equal, the deposit was unequal: in some situations openings having been made to insert side drains, bricks had been left in the sewer, against which considerable deposits had formed. The admission of water from collateral sewers at right angles and at different levels had also caused obstructions to the continuous flow along the main line. An example is given, where, although the collatera sewer was 3 ft. above the level of the r[illegible] a deposit of a foot in depth was formed for several hundred feet up the stream, while below the poi junction the sewer was perfectly clear. The insertion of gully-necks quently caused obstructions, by permitting the access of dirt and ru from the road.

These facts being ascertained, the next consideration was how to re the defects, as the locality would not permit an alteration of level, w would give a flow through the sewers sufficiently strong to carry off the de After a long series of experiments (by the author, who is engineer to Commissioners) and trials upon several kinds of apparatus, the arrange shown by Fig. 1 was decided upon:—it consists of an iron frame set i

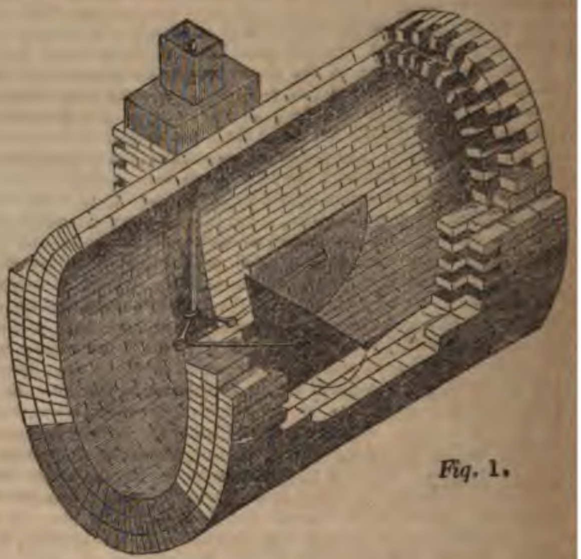
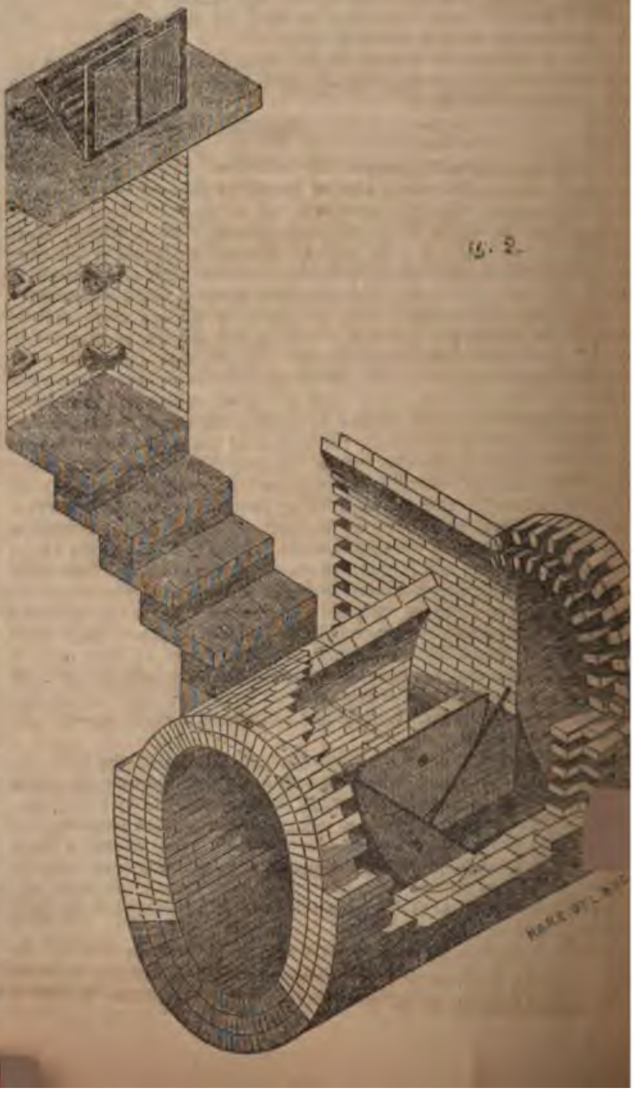


Fig. 1.



ig. 2.

sewer with a hinged door half its height, fitting with a water-tight joint: it is opened and closed by means of a jointed rod, which is worked from the level of the street. A head of water is allowed to collect against the closed door until it is sufficiently heavy, when the door being suddenly opened, the whole mass of deposit is carried forward by the rush of water. The operation is repeated with a head of 3 ft. of water at intervals of half a mile, until the whole of the accumulation issues at the outfall, thoroughly cleansing the sewer. After this arrangement of apparatus had been some time in use, an improved form with a side entrance, as shown in Fig. 2 was contrived, and is now generally adopted in situations which admit of it.

By this simplified arrangement the stop-gate can be worked without the mechanical contrivances of the other method, and an easy access is afforded to the sewers. This latter mode is generally adopted, and the success of the plan is stated to be perfect.

All the details of the construction of the stop-gates and the sewers, as well as of several improvements in the building of the gully-holes and collateral sewers, are given, with the result of the velocities of the currents of water from heads of various heights. Drawings of all the several kinds of apparatus invented by the author were presented, and the models which were exhibited were explained by Mr. Burton, the manufacturer of the flushing apparatus.

INDICATORS FOR STEAM ENGINES.

Mr. Farey exhibited and described one of a set of indicators for steam engines, made by Mr. Penn of Greenwich, for the French Government, to be used in trying experiments on the steam vessels in their navy. The construction was the same as those made by Mr. M'Naught of Glasgow; but the instruments were larger and better proportioned. Mr. Farey availed himself of the opportunity of describing the construction, the operation of, and the qualities required in a good indicator, and then exhibited a series of indicator cards, either taken by himself or by friends whose accuracy could be depended upon. They extended from the year 1817 at short intervals down to the present time, and showed a great improvement in the application of steam in engines: in fact, Mr. Farey was of opinion that the origin and progress of the modern improvements in engines might be traced by a series of cards carefully taken at various periods, and he promised to contribute a more extended communication on the subject during the ensuing session.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

July 11.

A paper was read giving a "*Description of the Roof suspended over the Panorama in the Champs Elysées, Paris,*" by M. Hittorff.

The Hon. Secretary, Mr. Bailey, observed, that although the Germans attribute the invention of panoramas to Prof. Breisig, of Dantzic, it is generally admitted that they are of English origin, and that the first was exhibited in 1793, by Robert Barker, in the city of Edinburgh. The most important building for such exhibitions, one far surpassing any at that time existing in foreign countries, was erected in London by Mr. T. Horner, and is known as the Colosseum, Regent's Park. The plan is a polygon of sixteen compartments, whose interior diameter measures about 123½ ft. The dome is constructed of timber, curved and arranged upon the principle of Phillibert de Lorme, and is covered with copper. In the centre of the building are two concentrical cylinders supporting three galleries, as well as supporting the centre of the dome or roof. The rotunda since erected in Paris surpasses in magnitude even this vast edifice. Among the various designs for embellishing the Champs Elysées, M. Langbois suggested the idea of a rotunda for the exhibition of panoramas. The ground was granted to him for a term of 40 years by the Municipal Council on the following conditions:—

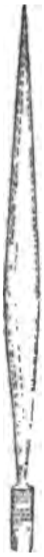
1. The diameter of rotunda to be 130 ft.
2. The roof to be conical, and without a central kingpost.
3. The rotunda to be lighted by a cycle of glazed sashes.
4. The intervention of any obstruction between the sashes and the wall of the rotunda (thereby casting a shadow upon the canvas) to be carefully avoided.
5. And finally, all these data to be severally complied with at the least possible expenditure.

Considering the difficulty of constructing a building of such dimensions without a central kingpost, and the great expense of arched timberwork, together with the solid structure of the walls indispensably requisite to resist the thrust of the wooden vault, the artist resolved to apply (in the construction of the new building) the principle of suspension adopted for bridges, by means of chain cables. The site of the rotunda not allowing of the adoption of stays fastened at a distance from the building, it was necessary so to contrive the buttresses that they should hold the cables and resist their tension. Their number, amounting to 12, gives a subdivision of the wall of the rotunda into arcs; and it may be considered, at the level of the stone cornice, as a polygon, whose sides adjacent to one and the same buttresses offered a twofold force opposed to the strain of the cables. In this way the resistance was obtained nearly at the expense of the cornice and the wall; and by adopting two circles with the cables passing between these circles, the upholding chains can be strained as required. These cables pass at an angle upwards, over vertical rods, which rest on pivots on the inner edge of the cornice wall, which is about 3½ ft. in thickness; they then rest on the outer edge of the cornice wall, and the ends of the cables are carried to the abutment walls and are there fastened. The building was commenced in October 1838, and covered in January 1832. It attains a mean height of nearly 50 ft., occupying a surface of nearly 21,653 square ft., and its circumference is composed of a mass of building above 16 ft. in depth, having three stories distributed into apartments over a space of 520 ft.; and the cost of the whole was about £13,000.

Mr. T. H. Wyatt directed attention to Forster's Patent Stoneware slabs for preventing damp rising in walls. He had found from experience, that slate was not only porous, but too brittle for the purpose, particularly where houses or buildings are likely to settle; whereas this material is not only impervious to wet, but can be made to any thickness, and sufficiently strong to resist the greatest pressure.

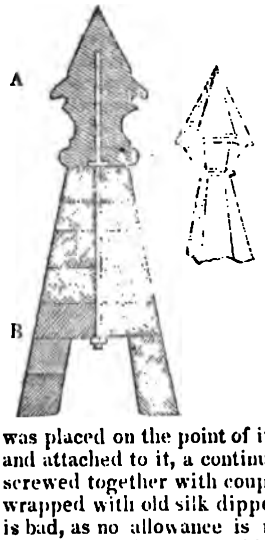
ON LIGHTNING CONDUCTORS.

SIR—Having erected several lightning conductors on Mr. John Murray's principle, a description of them may not be an uninteresting subject for your Journal.



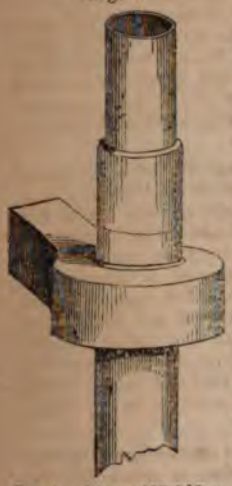
The head is a copper gilt point, 2 ft. long, 1½ inch diameter in the thickest part. screwed into a ¾ in. bore copper gas tube, which is perforated just below the insertion of the head ("to allow the electric matter to act upon the external and internal surfaces," as Mr. Murray directs in his Essay on Aerial Electricity), and must be continued in as straight a line as possible to the foundation of the building, where it must terminate in a trough filled with water.

The first erected by me was at Kirkstal church, near Leeds, the spire having been struck by lightning on the 29th April, 1833; the finial and stones of the upper part were secured by a wrought iron bar formed as at A, terminating at 5 feet below the finial, a 4-inch flange being sunk into the finial and bedded upon the top stone of the spire; at the bottom of the iron bar was a washer, screw and nut, to tighten the shaft joints, and add to the security against high winds by the increased weight of the mass; the finial was fixed on to the bar with Roman cement. From this nut to the bell was a space of 40 feet, with no intermediate metal except the chain bar of iron at the base of the spire on the line of the cornice. The fluid passed through the north belfry window in a north-easterly direction, leaving the chain bar and the bell uninjured, but the north-east face of the octagon spire was burst asunder, the north-east pinnacle and part of the buttress destroyed, as also the north lucarne of the spire, and the buttress shaft cut obliquely towards the lead flashing of the roof of the body, which was torn up, and the north west pinnacle thrown from the buttress shaft, all the corner stones disturbed, and the slates broken by the stones of the tower and spire, and considerable damage was done inside the building; the finial A and the lower stone B were so shattered that had not the molding of A been different to any other, I should not have discovered that it had been a portion of it; this was found 80 yards from the building, and the fragment did not contain 3 cubic inches; the stone was 2 ft. 9 in. high, and 2 ft. 3 in. diameter; the lead appears to have attracted the electric fluid on its explosion in the spire, yet that on the south side escaped injury altogether. When the spire was rebuilt, a copper gilt cross was placed on the point of it, the lightning rod extending 2 feet above and attached to it, a continuous line of tube formed by 9 feet lengths, screwed together with couplings, which rests upon holdfasts of iron wrapped with old silk dipped in melted tallow; this plan of coupling is bad, as no allowance is made for the expansion of the metal, and consequently during the third summer one of the joints close under the belfry window broke, but as the lower part of the rod has not left the upper more than 2 inches, I believe it to be of little consequence as the stream would be *almost continuous*; this rod terminates under ground in a stone trough about 2 ft. 6 in. deep, and 18 inches square, which forms part of the line of drains round the church, made to convey the rain water from the spouts, and so placed below the drains that it must be always full. I have since this attached one to the



spire of St. Paul's church at Birkinshaw, one at Farnley, and one to Trinity church steeple in this town, (the latter 173 feet high), and one to the new church at Hendingley, 3 miles from hence; the joints are made more perfect than in my first, by soldering a portion of smaller tube about one inch down into the lower tube and 6 inches long into the upper tube (see fig.4) below which part I fix the holdfast of painted iron, insulated with silk; the neck of a bottle would be perhaps still better as more perfectly insulating the tube, or a block of cast glass the size of half a brick, with a loop or an eye, would be more secure (see fig. 6); upon the lesser tube the upper one slides, and allows of expansion and contraction without separating the parts of the tube, which is desirable for its gravity as were the parts separated, an explosion would take place at each termination though slight, unless there were other metal nearer.

Fig. 4.



The advantage of a tube is that a greater surface is exposed to the action of the electric fluid, an inch rod presenting little more than a surface of 3 inches, whereas the ¾ inch bored tube gives 2¼ inches inside and 3 outside, or from 5¼ to 5½ inches together, and the rapidity with which the fluid passes over it, ensures it from fusion. In all cases the rod or point should be gilt to prevent oxidation, and were the tube also gilt it might be more advantageous. Since the erection of these conductors, very heavy thunder storms have passed over all the places without effecting them, whereas the new church at Doncaster had its spire partly destroyed although armed with a glass globular repeller. St. Paul's church and the new Infirmary at Huddersfield which have conductors erected under Mr. Murray's directions have escaped. So many churches have been struck by lightning in different parts of the country, that no architect should attempt to construct a spire without one of these conductors, especially as the cost is so trifling, and any village blacksmith or tinman could make the machine and attach it to either tower or spire; to ascend the spire, a short ladder may be easily raised against the face of one plane of the octagon or other figure or plan, the ladder being prepared by nailing a cross piece of wood at each end; this will give foot hold, and the rope fastened to the bottom, tightened round the base of the spire, and another rope tightened round the top of the ladder, will give a secure foot hold for raising a longer ladder to be prepared and secured in the same manner as the first, so that two or more ladders lashed together, when the height is more than can be reached by an ordinary ladder, will enable the workmen to get to the summit of any spire in the kingdom without the necessity of erecting an expensive scaffolding, should the spire have been left unprovided with a conductor, or in the case of many of our beautiful old spires, several of which have been injured. The total cost when put up before scaffolding has been removed, has not in any case exceeded 18*d.* per foot lineal, including the tank; it has been considered in the case of a tower with pinnacles, that each pinnacle should have a conductor: I think one would suffice, the other pinnacles being immediately upon their apex, a glass repeller. Murray observes of the lightning conductor or paratonnerre, like the paragrele or hail rod, that it protects a surface around it having a radius equal to double the height of the point from the surface of the earth, or that 150 feet in height would protect a circular area 600 feet in diameter. I send you a sketch of Kirkstal church spire as it appeared after struck by lightning, with a tracing from a sketch of New Mills church, in Derbyshire, which is of the same form and dimensions as Kirkstal, having no drawing of the latter.

Fig. 5.—Plan of Holdfast.

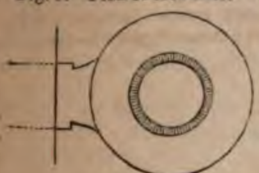
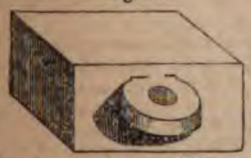


Fig. 6.



I am, Sir, your most obedient servant,

R. DENNIS CHANTRELL.

Leeds, 30*th July*, 1842.

A steam frigate, launched on the 8th ult. at Cherbourg, is the largest steamer ever built there. Another of the same power is to be launched in September. Altogether the French Government has, say the French railway papers, five first class steam frigates in hand.

YORKSHIRE ARCHITECTURAL SOCIETY.

WE learn with pleasure that active steps have been taken for the establishment of a "*Yorkshire Architectural Society*," under the patronage of his Grace the Archbishop of York, and the Lord Bishop of Ripon. At a preparatory meeting, held in Leeds on the 26th July last, Dr. Hook in the chair, the following resolutions were adopted :—

"1. That a Society be formed, entitled THE YORKSHIRE ARCHITECTURAL SOCIETY.

"2. That the objects of the Society be, to promote the Study of Ecclesiastical Architecture, Antiquities, and Design, the restoration of mutilated Architectural Remains, and of Churches or parts of Churches which may have been desecrated, within the county of York; and to improve, as far as may be within its province, the character of Ecclesiastical Edifices to be erected in future.

"3. That the Society be composed of Patrons, Presidents, and Vice-Presidents; and of ordinary Members to consist of such Clergymen and Lay Members of the Church as shall be admitted according to the subsequent rules.

"4. That His Grace the Lord Archbishop of York, and the Lord Bishop of Ripon, be requested to extend their patronage to this Society.

"5. That the Lord Lieutenants of the three Ridings of the County of Yoik be requested to accept the office of Presidents.

"6. That the following Noblemen and Gentlemen be requested to accept the office of Vice-Presidents :—

* * * * * *

"7. That new Members be proposed and seconded by Members of the Society at one of the meetings, and elected at the next, and that Honorary Members be elected only on the nomination of the Committee.

"8. That Rural Deans within the County of York be considered on their signifying their intention to become Members, as *ex officio* Members of the Committee.

"9. That each Member shall pay ten shillings at his admission, besides an annual subscription of ten shillings, to be due on the first of January in each year; but that the admission fee of those who may become Members before the 31st December next, be considered as their subscriptions for the current year.

"10. That any Member may compound for all future subscriptions by one payment of five pounds.

"11. The affairs of the Society shall be conducted by a Committee, composed of the President, Vice-President, and thirty-six ordinary Members, (of whom five shall be a quorum), who shall be elected at the Annual Meeting, and of whom twelve at least shall have been Members of the Committee of the preceding year.

"12. That the Committee elect out of their own body, a Chairman, and so many Secretaries as may be rendered necessary by the large extent of the county.

"13. That the Society meet for the reading of papers, and the dispatch of ordinary business, in the spring and autumn of each year: the meeting in autumn to be considered the public annual Meeting.

"14. That each Member be allowed to introduce a friend to the ordinary Meetings of the Society.

"15. That donations, both of money and of books, plans, casts, and drawings, be solicited, and that the Committee be empowered to make such additions to the collection of the Society as may be deemed necessary.

"16. That the library, casts, and portfolios of the Society, be under the charge of the Secretaries.

"17. When the Committee shall consider any paper worthy of being printed at the expense of the Society, they shall request the author to furnish a copy, and shall decide upon the number of copies to be printed; provided always that the number be sufficient to supply each member with one copy, and the author and secretaries with twenty-five copies each; the remaining copies may be sold at a price fixed upon by the Committee. All other questions relating to publishing papers, and illustrating them with engravings, shall be decided by the Committee.

"18. That Christopher Beckett, Esq., be requested to accept the office of Treasurer; that E. J. Teale, Esq., be requested to accept the office of auditor of the Society's accounts; and that the Rev. Geo. Ayliffe Poole, Rev. Joshua Fawcett, and Samuel Wilkinson, Esq., be provisional Secretaries, until the office be filled according to rule 12.

"19. That the Oxford Architectural Society, the Cambridge Camden Society, the Exeter and Lichfield Diocesan Societies for Promoting the Study of Ecclesiastical Architecture, and the Durham Architectural Society, be requested to accept free admission for their Members to all the meetings of this Society; and that every attempt be made to reciprocate in all good offices with Societies of kindred objects and constitution."

CAOUTCHOUC CEMENT.

Specification of a Patent granted to ALFRED JEFFERY, *of No.* 8, *Lloyd-street, Pentonville, Gent., for a new method of defending the sheathing of ships, and of protecting their sides and bottoms.*—[Sealed 29th April, 1841.]

THIS invention consists in the production of various solutions and mixtures, for preparing oakum for caulking, and paying the seams, and coating the sheathing of ships. The solutions are three in number, viz., turpentine caoutchouc solution, naptha caoutchouc solution, and coal-oil caoutchouc solution.

The turpentine caoutchouc solution is formed by dissolving one part, by weight, of caoutchouc, in twelve parts, by weight, of spirits of turpentine.

The naptha caoutchouc solution consists of one part of caoutchouc, dissolved in twelve parts of rectified coal naptha.

The coal-oil caoutchouc solution is produced by dissolving caoutchouc in coal-oil, the proportions being the same as in the two former solutions.

The mixtures are asphalte mixtures, Nos. 1 and 2, and lac mixtures, Nos. 1 and 2.

The asphalte mixture, No. 1, consists of two parts, by weight, of powdered asphalte, dissolved in one part of the naptha caoutchouc solution.

The asphalte mixture, No. 2, is composed of two parts, by weight, of asphalte, dissolved in one part of the coal-oil caoutchouc solution, and to four parts of this mixture, one part of a solution of corrosive sublimate is added. This solution is prepared by dissolving two parts of powdered corrosive sublimate in three parts of white naptha, in a glazed earthenware vessel, and then adding three parts of coal-oil to it.

The lac mixtures, Nos. 1 and 2, are prepared in a similar manner to the asphalte mixtures, with this exception, that lac is employed instead of asphalte.

Oakum is prepared for caulking by soaking it in either the turpentine or naptha caoutchouc solutions; the superfluous solution is then pressed out, the fibres separated, and the oakum being dried, is ready for use. The asphalte mixture, No. 1, or the lac mixture, No. 1, is used for paying the seams.

The sides and bottoms of ships are protected by a coating of the asphalte or lac mixtures, one-eighth of an inch thick; either of the mixtures No. 1, may be applied to the parts above water, or for the first coat of the parts below water; but one of the mixtures No. 2, must be used for the remaining coats, which the under parts of the vessels receive. The mixtures are applied, when hot, by means of a brush, each coat being allowed to dry before the following one is laid on, and the surface of the last coat is smoothed by the application of heat.

The patentee claims, firstly, the method, by the means herein described, of defending the sheathing of ships, and of protecting their sides and bottoms; secondly, the application of caoutchouc for the same purpose; and thirdly, the application of lac for effecting the same object.

STEAM NAVIGATION.

GOVERNMENT STEAMERS.

We are glad to see that Government is beginning to form a fleet of steamers, on an increased scale. We have the *Penelope*, 42-gun frigate, now having 60 ft. added to her length at Chatham; she is to have a pair of the Gorgon engines of 625 H.P., by Messrs. Seaward and Capel. The total cost of the engines will be £28,000: this vessel is in a forward state. Another vessel of 1650 tons burden is to be built under the superintendance and from the lines of Mr. Oliver Lang, master shipwright of Woolwich dock yard, and to have a pair of engines of 800 H.P. Another vessel of equal magnitude is to be built at Chatham dock yard, which was intended to be called the *Dragon*, but we are happy to announce that she is to be named the "James Watt." This is as it ought to be: we have here a name revered by every engineer, and we may say by every Briton. She is, we understand, to have the double cylinder direct action engines of Messrs. Maudslays and Field. We hope that Government will not stop here; we must have at least a dozen of such vessels; we shall then only be just a-head of the French Government, who, we know, are constructing steam vessels of a larger magnitude than any of our present class. This must not be allowed; we must have the ascendancy of the ocean. We have both the metal and the men to construct engines upon a large scale, at a *short notice*. They only want the support of the Government; and with such aid, we shall be able to keep Old England a-head of all the world.

The Queen.—This steam boat, which was engaged last month to convey the Lords of the Admiralty from London to Woolwich, was built by Messrs. Rennie. Her performance is remarkably good; at her first trial, we are informed that her speed at the measured mile was equal to nearly 16 statute miles through the water per hour, with 32 strokes per minute. The vessel is 160 ft. long, 16 ft. 6 in. beam, and 8 ft. deep; burthen 219 tons: draught of water 4 ft.; midship section of immersion 44 ft. She has two engines of 35 H.P. each, or as 1 H.P. to 3 tons. The weight of engines, including water in boilers, wheels, &c., complete, 35 tons. Nothing can be more beautiful than the motion of the vessel through the water, which it seems to divide without a ripple. She is perfectly stable and stiff; in going down the river from Long Reach Tavern to Gravesend Church, the distance of 9 miles, with tide, was done in 27 minutes.

The *Megæra steam vessel* has been fitted with tubular boilers by Messrs. Seaward and Co., being the first man-of-war steam vessel fitted with boilers of that description.

The *Rocket*, iron steam vessel, built by Messrs. Fairbairn and Company, at their establishment in the Isle of Dogs, for the service of Government, has been taken charge of by the officers of Woolwich Dockyard.

The *Meteor* steam vessel, Lieutenant-Commander G. Butler, towed down to Greenhithe at the beginning of last month, a chain lighter with some buoys and mooring chains, to be laid down in that part of the river under the direction of Mr. Tinmouth, master-attendant of Woolwich Dockyard, as it is intended in future that the vessels built, refitted, or otherwise altered here, be swung at Greenhithe, in order that the variation of their compasses may be adjusted under the immediate superintendence of Captain Johnson, previous to their proceeding to sea.

The Montezuma Steam Frigate.—At a trial voyage of the above-named magnificent vessel took place from Blackwall to the Lower Hope and back. It is stated that she steamed at the rate of 10½ miles an hour against tide both ways, the engines making 21 strokes per minute. The Montezuma, although of the burden of 1,100 tons, draws no more than nine feet water when fully equipped, and is built to carry two swivel guns, 68-pounders, on the upper deck, besides the usual number of small guns. She was constructed at the yard of Messrs. Wigram and Green, at Blackwall, and her engines, which are of 300-horse power, and constructed on almost a similar principle to those on board Her Majesty's steam-frigates Driver, Gorgon, Styx, &c., were supplied and fitted by the firm of Messrs. Seaward and Capel. These engines can have the steam cut off at half stroke, so as to act on the expansion principle.

Canada.—An iron steamer, for the use of the royal navy on Lake Ontario, has lately arrived out from home. It came, of course, in pieces, but the Government having sent out competent persons, it is to be put up forthwith. In the same vessel which brought out the iron steamer arrived the magnificent engines by Messrs. Boulton, Watt, and Co. of the steam frigate *Cherokee*, now almost ready for launching.—*Times.*

MISCELLANEA.

Woolwich Dock Yard.—One of the best pieces of granite masonry that we have ever seen is now executing at this dockyard, in the construction of the new dry dock, it is built with blocks of granite of large dimensions, laid in radiating courses, and worked with great precision and hammer dressed. Messrs. Grissell and Peto are the contractors to whom this work is intrusted under the direction and superintendence of Messrs. Walker and Burgess. A powerful steam-engine by Boulton, Watt, and Co. has been erected for the purpose of withdrawing the water within a very limited time when vessels are docked to be examined. Some idea may be formed of the magnitude and complete arrangement of the new dock when it is stated that it is sufficiently large to admit, for the purpose of being docked, ships of equal dimensions to the Trafalgar, of 120 guns, and that the volume of water requisite to float vessels of that size could by the power of the steam engine be completely withdrawn into the basin at high water or into the river at ebb tide in about 20 minutes, and in the event of the vessel examined being found sound and not in want of any repairs she might again enter the river ready for service without losing a tide. These are improvements in celerity of movement which cannot fail to prove of great importance to the country in the event of war with any foreign Power at a future period. The engine connected with the dry dock has been erected in a handsome and substantially constructed building, and on the top an iron tank has been placed capable of containing 190 tuns of water, and which will always be kept full in case of accidents from fire at the end of the yard in which it is situate.

Stucco Paint Cement.—We have examined some specimens of this cement upon plaster, slate, and wood. It has all the appearance of stone, and forms a complete impermeable coating, and answers the combined purpose of both paint and cement; it is manufactured and sold in a fluid state, like white lead, and when used it is mixed with sand, in the proportion of 3 of the latter to 1 of the former, and laid upon brickwork in the usual manner. If used upon brick, it requires about 7 lb. of the fluid cement, and if upon plaster about 4 lb.: it is sold at 12*s.* per cwt. For damp situations, and for walls exposed to a south-western aspect in the country or on the sea side, it will be invaluable. Specimens may be seen at the Bernasconi Gallery, Chenies-street, Bedford-square.

Hereford.—St. Nicholas' New Church was consecrated 11th August last. This church is beautifully situated at the Friars, a very short distance from the site on which the old church stood, leading to the Barton, extending east to west from Victoria-street to Friars-street. The style of architecture is that of the early English; the plan is a parallelogram, with a tower at west, and chancel and vestry at east, projecting beyond each end. The walls are built of neatly hammer dressed wall stone, the buttresses and dressings being tooled. The sides are divided into compartments by buttresses in two stages; the upper part terminating with coping of parapet by weathered canopies. In each compartment are placed lancet windows, with neat hood-moulds, terminating on carved bosses. The chancel is flanked by plain buttresses and octagonal pinnacles with carved finials; in the gable is an open trefoil for ventilation, and below are three lancet windows, united by their hood-mouldings, terminating upon carved bosses, and glazed with ground glass, surrounded by a border of rich stained glass, producing a soft and beautiful light. The tower is flanked by massive double buttresses, the lower and upper offsets terminating in weathered canopies; in the centre of the tower is the west entrance, the tower forming a vestibule, in which is the gallery stairs. On the south side is a neat porch with inner folding doors. Down the centre of the church is a very spacious aisle fitted with free seats; upon each side is a double row of pews with stall ends and cast heads. Over the west entrance is an organ loft and gallery with cast iron railings in front. The pulpit and reading desk are on each side the aisle leading to the altar, which is approached by two steps, and surrounded by a handsome railing. The building is ceiled to the rafter, showing the timbers of the roof, the trusses of which are filled with tracery. The church is 81 ft. long and 48 ft. 6 in. wide in the interior, and contain 800 sittings, 350 of which are free. The entire edifice is highly creditable to the architect Mr. Duckham.—*Hereford Times.*

Kentish Town Church.—A view of the exterior and interior of this intended church, designed by Mr. Bartholomew, has been published, it was chosen out of a competition of 5. It is to be built from a grant of £800 by the Church Commissioners, and from private subscriptions, towards which the Queen Dowager, the Bishop of London, Earls Dartmouth and Mansfield, and many of the wealthy inhabitants of the neighbourhood contributed largely. The site is that of the present parochial chapel: the cost is to be, including the materials of the present chapel, about £6000, and the number of persons to be accommodated 1650. The altar, chief entrances, and principal façade, are towards the east, whence peculiarities of confrmation result. The plan is a parallelogram with two very short transepts. The western of these transepts spreads out the rear elevation, as seen over the Hampstead fields, to great breadth; these are flanked by turret staircases, and the eastern transept being unencumbered by galleries, leaves a free and open chancel. Below the great altar window a low apsis projects, for the purposes of a vestry, and the altar recess is flanked by two steeples about 50 ft. high, to contain staircases, bell, clock, &c. It is the architect's wish to raise these by an extra fund to upwards of 130 ft. The internal effect and construction are altogether original: arches span the fabric in all directions, interchangeably counter-abutting each other, rising from four iron columns and four piers, containing cores of iron. The arches which span the nave spring from half length figures of the four evangelists. Wherever the arches reach the external walls they are restrained by massy buttresses, detached at bottom from the walling, and ascending with lofty pinnacles, giving great strength and play of external effect. The roofing is peculiar: all the rafters are rendered passive by being laid horizontally; those to the clerestory bear upon arches about 7 ft. apart, and the roofs of the aisles, by being gabelled against the clerestory, both restrain any ulitmate derangement which these arches might suffer, and increase the picturesqueness of the flanks of the building. All the roof work is to be stained oak colour; there is to be no plastering whatever about it. The body of the church is to be illuminated by six plain lancet windows, four three-light columnar windows with tracery, and nine ornamental rose windows. The altar, besides the great painted window, is to have four smaller windows to be filled with stained glass containing the decalogue, creed, &c. with sacramental borders of corn and vines; and below these again will run all round the altar recess a series of canopies, supported upon slender columns with foliaged capitals of stone (already in existence), and which are of rare beauty. In the centre, under the altar table, will be a relief of the Coming to the Holy Sepulchre. The material is to be externally white brick, and all the canopies, capitals, (except those last-mentioned) finials, crosses, shields, panels, and most of the other decorations, are to be of terra cotta or vitrified stone, durably emblocked into the walling, and not attached by cramps and pins. The style is the decorated early English, or early decorated, the combined mass and slenderness of the French cathedrals, Lincoln cathedral, and other buildings of similar date, being imitated: all the capitals, of which there are some hundreds, are foliated.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 29TH JULY TO THE 25TH AUGUST, 1842.

Six Months allowed for Enrolment, unless otherwise expressed.

THOMAS BELL, of Saint Anstil, Cornwall, mine agent, for "*improvements in the manufacture of copper.*"—Sealed July 29.

JULES LEJEUNE, of Regent's park, engineer, for "*improvements in accelerating combustion, which improvements may be applied in place of the blowing machines now in use.*"—July 29.

JOHN STEPHEN WOOLRICH, of Birmingham, chemist, for "*improvements in coating with metal the surface of articles formed of metal or metallic alloys.*"—August 1.

ALFRED JOHN PHIPPS, of Blackfriars-road, gentleman, for "*improvements in paving streets, roads, and ways.*"—August 1.

JOSEPH WHITWORTH, of Manchester, engineer, for "*improvements in machinery or apparatus for cleaning roads, and which machinery is also applicable to other similar purposes.*"—August 2.

JOHN DRY, of Beverley, agricultural implement maker, for "*improvements in thrashing machines.*"—August 2.

SAMUEL CARSON, of Covent Garden, gentleman, for "*improvements in purifying and preserving animal substances.*"—August 3.

ARCHIBALD TURNER, of Leicester, manufacturer, for "*improvements in the manufacture of muffs, tippets, ruffs, mantillas, cloaks, shawls, capes, pelerines, boas, cuffs, slippers, and shoes.*"—August 3.

JOHN LEE, of Bermondsey, gentleman, for "*improvements in wheels and axle-trees to be used on railways, and in machinery for stopping on, or preventing such carriages from running off railways, which improvements may also be applied to other carriages and machinery.*"—August 3.

CHARLES HENRI PERRIN, of Lombard-street, London, for "*improvements in the construction of certain parts of the mechanism used in watches and chronometers, which improvements are also applicable to some kinds of clocks.*"—August 8.

DAVID NAPIER, of Millwall, engineer, for "*improvements in steam engines and steam boilers.*"—August 9.

THOMAS WALKER, of Birmingham, stove maker, for "*improvements in stoves.*"—August 9.

RICHARD FORD STURGES, of Birmingham, manufacturer, for "*an improvement in the manufacture of Britannia metal and plated wares.*"—August 10.

DOMINIC FRICK ALBERT, of Cadishead, Doctor of Laws, manufacturing chemist, for "*a new combination of materials for the purpose of manufacturing a manuring powder.*"—August 10.

MOSES POOLE, of Lincoln's Inn, gentleman, for "*improvements in paving or covering roads and other ways.*"—August 11.

JOSEPH BETTELEY, of the Brunswick Anchor Works, Liverpool, chain cable manufacturer, for "*improvements in windlasses and machinery for moving weights.*"—August 11.

JOHN THOMAS BETTS, of Smithfield Bars, gentleman, for "*improvements in covering and stoppering the necks of bottles.*" A communication.—August 11.

GEORGE ROBERTS, of Liverpool Road, miner, for "*improvements in the construction of lamps.*"—August 15.

WILLIAM RAYBOULD, of Clerkenwell, brass founder, for "*a new or improved soldering iron.*"—August 18.

GEORGE JOHN NEWBERY, of Cripplegate buildings, artist, for "*improvements in producing damask and other surfaces on leather and other fibrous substances and fabrics.*"—August 18.

NATHAN DEFRIES, of Fitzroy-square, engineer, and NATHANIEL FORTESCUE TAYLOR, of Mile End, engineer, for "*improvements in meters for gas and other fluids.*"—August 18.

WILLIAM RIDGWAY, of Stafford, earthenware manufacturer, for "*a new method of conveying and distributing heat in ovens used by manufacturers of china and earthenware, and brick, tile, and quarry makers.*"—August 18.

GOLDSWORTHY GURNEY, of Great George-street, gentleman, for "*improvements in apparatus for producing, regulating, and dispersing light and heat.*"—August 18.

RICHARD ELSE, of Gray's Inn, Esq., for "*improvements in machinery or apparatus for forcing and raising water and other fluids.*"—August 18.

THOMAS HENDRY, of Glasgow, mechanic, for "*improvements in machinery for preparing and combing wool, and other fibrous materials.*"—August 25.

DAVID REDMUND, of City Road, engineer, for "*improvements in hinges or apparatus applicable to suspending or closing doors and gates, and other purposes.*"—August 25.

ERRATA.

In Mr. Hodgkinson's paper, at top of col. 1, p. 275, instead of the third column of the table, read Ratio of mean *tensile* to *crushing strength.*

1 to 0·55
I to 6·6
1 to 7·8
I to 10·5 or 8·9 taking the hardest only.

South-Eastern Railway—line 25, page 262, instead of the pressure being "increased in the ratio of the square of two to unity," it should be "increased in the ratio of the square *root* of two to unity."

Page 251, col. 1, line 28, for *Avaca* read *Cloaca.*

TO CORRESPONDENTS.

We have received from Mr. Sevrell, C. E., *of New York, a drawing and description of a disconnecting crank for marine steam engines, dated Feb.* 1842; *we do not consider it so efficient or so simple as that of Mr. Trewhitt, described in the Journals of last Feb. and June.*

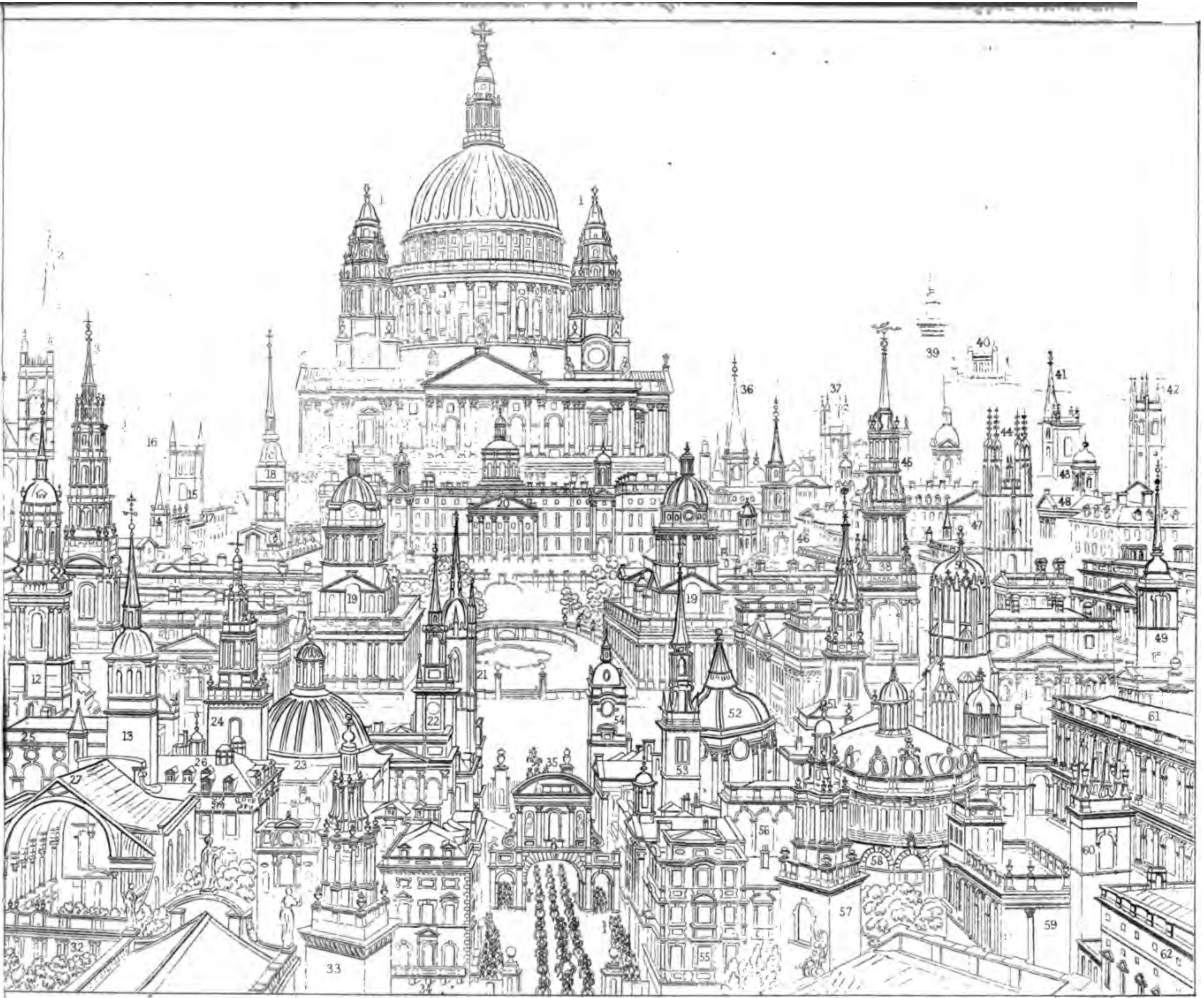
"O. T."—*We feel obliged for his communications—they shall be inserted next month.*

Mr. Robertson's Paper on Railway Signals we have been obliged to postpone for want of room.

We have been obliged to postpone our plate until next month, and instead we have given an extra sheet, with numerous wood engravings.

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant, addressed to the Editor, No. 10, Fludyer Street, Whitehall.

Vols. I, II, III, and IV, may be had, bound in cloth, price £1 each Volume.



Alex^r Hill, Publisher 67 Princes St^t Edin^r

"TRIBUTE TO THE MEMORY OF SIR CHRISTOPHER WREN."

WITH AN ENGRAVING, PLATE XII.

Names of the Public Buildings referred to in the annexed Plate.

aul's Cathedral.
hester Cathedral (repaired).
ride's Church, Fleet Street.
tminster Abbey (Towers).
edast, Foster Lane.
st's Church, Newgate Street.
Souls' College, Oxford.
ene't's, Gracechurch Street.
st's Hospital.
artholomew, by the Exchange.
agnus, London Bridge.
eter's, Cornhill.
Michael's, Wood Street.
Hallows', Bread Street.
er of St. Michael, Queenhithe.
lborough House.
Martin's, Ludgate.
al Hospital at Greenwich.
chester Palace.
unstan's in the East.

22. St. Lawrence, Jewry.
23. St. Stephen's, Walbrook.
24. Tower of ditto.
25. St. Michael, Queenhithe.
26. Buildings in Lawrence Pountney Hill.
27. St. James's Westminster.
28. St. Bennet, Paul's Wharf, City.
29. Buckingham House.
30. Hampton Court Palace.
31. St. Nicholas Cole-Abbey, Old Fish Street.
32. Colonnade at Hampton Court.
33. St. Michael Paternoster Royal.
34. Entrance to Doctors' Commons.
35. Temple Bar.
36. St. Margaret Pattens, Rood Lane.
37. St. Mary Aldermary, Watling Street.
38. St. Mary-le-Bow, Cheapside.
39. The Monument.
40. Observatory at Greenwich.
41. St. Anthony, Watling Street.
42. St. Albans, Wood Street.
43. St. Andrew's, Holborn.
44. St. Michael's, Cornhill.
45. St. George's, Botolph Lane.
46. Morden College.
47. Old Custom House.
48. Chelsea Hospital.
49. St. Margaret's, Lothbury.
50. Tower of Christ's Church College, Oxford.
51. St. Edmund the King, Lombard Street.
52. College of Physicians.
53. St. Augustine, Watling Street.
54. St. Bennet Fink, Threadneedle Street.
55. Old Mansion House, Cheapside.
56. St. Matthew's, Friday Street.
57. St. James's, Garlick Hill.
58. Sheldonian Theatre at Oxford.
59. Trinity College Chapel, Oxford.
60. St. Mary Somerset, Thames Street.
61. Trinity College Library, Cambridge.
62. Buildings in Doctor' Commons.

ublication of an engraving from Mr. Cockerell's design, illus-
ll the principal works of Wren, appears to us a fitting oppor-
r laying before our readers some account of that great man,
ronological list of his works. The drawing by Mr. Cockerell,
no less than sixty public structures, admirably grouped to-
o as to produce a beautiful picturesqe effect; it attracted
tention when exhibited at the Royal Academy in 1838. Now,
pirited enterprise of Mr. Hill, of Edinburgh, the publisher,
id line engraving on a large scale has been executed by Mr.
son, in the first style of art, which will place this work at the
l of Wren's numerous admirers in England, on the continent,
ie new world. We heartily commend it to their patronage.
-plate, which we insert in the present number, will, in our
be always accessible for reference, while the engraving itself
abiding record of the labours of the most distinguished
English architecture, and a work so immediately connected
sympathies of Englishmen and of English architects, we hope
the studio of every member of the profession.

TOPHER WREN was born on 20th Oct, 1632, at East Knoyle,
hire, of which parish his father, Christopher Wren, Dean of
, was rector. In this parent he had the advantage of pos-
man of learning, by whom his precocious talents were nursed,
whom he derived his attachment to mathematical studies.
udying at Westminster School, one of the most illustrious
es in England, he entered at All Souls' College, Oxford, where
the degree of Bachelor and subsequently of Master of Arts,
rwards acquired a Fellowship. For success in life he pos-
strong guarantees in the shape of extensive and profound
, and powerful connexion. The son of a dignitary who had
good service to the royal cause, he was also the nephew of
Wren, a most violent Carlist partisan. His sister, too, is
as being in the good graces of Charles II. for curing him of
in the hand by her surgical skill. History sayeth not, but
like Newton, Marlborough, and others of his eminent con-
ries, Wren might have been indebted for some portion of
ment to feminine interest. However leagued with the royal
e was of too easy a disposition to allow such prepossessions to
his way, for we find him, early in life, commended to the
f the Lord Protector Cromwell, and, like Dryden, commencing
r under his patronage. The Protector even offered him to allow his uncle Bishop Wren's release from the Tower, but that furious zealot liked martyrdom too well to accede to the conditions. The young Wren must, indeed, have been, as he is represented, of very unworldly character to charge himself with such a mission; for instead of finding it received as a boon, it was rejected by the Bishop with the greatest indignation. It was not the fashion of that day to let party stand in the way of personal advancement, and young Wren continued his court to the "greatest man" of the day, and pressed forward into the career of scientific advancement, which was opened to him. Wren's chief glory is in some degree his misfortune, the height of his fame in one department has obscured his proficiency in others, and in becoming the great architect of his day, he has lost the fame of being one of its greatest philosophers. To his precocity we have already alluded, and to his inclination for mathematical studies; he was placed in a school well calculated to bring forth his energies; for in those days, Newton being unborn, Oxford had not yet ceded to her younger sister mathematical supremacy. Oxford was also the cradle of the Royal Society, in which Wren was early enrolled, and he had thus full scope for the exertion of his talents, and abundant promise of their being duly appreciated. As a mathematician Wren ranks as one of the first of his day,* and to his last day, he continued devotedly attached to that favourite pursuit. As his youth began with that study, and his earliest compositions were directed to it, so the last years of his life were spent in the correction of the labours and observations of sixty years. It was Wren who successfully accepted Pascal's famous challenge to the mathematicians of England, and returned the defiance with a problem which Wren himself was alone able to answer. As a practical and theoretical astronomer, he distinguished himself by his observations on the cometary system, and on the satellites of Jupiter, and by anticipating Huygens in assigning the theory of Saturn. He suggested the use of a certain part of the length of a degree as a standard of measure. For the improvement of navigation and the instruments used in that art, in surveying and in the sciences of observations, he gave to the world many valuable inventions. He is a claimant for the honour of inventing the barometer, and many of its practical applications. For the study of optics he equally exerted himself; he applied himself to perspective and to the devising of optical instruments. If such was the varied range of his mathematical pursuits, natural studies did not less occupy

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* See Hutton's Mathematical Dictionary, article Wren.

him. He was an attentive student of physiological phenomena, and the acknowledged assistant of Scarborough and Willis, to whose works he contributed anatomical drawings. His biographers claim for him the invention of the process of injecting liquids into the veins of living and dead animals; and also, in furtherance of the study of natural history, the origin of what is called micrography, or the delineations of objects as seen by the microscope. In these studies he was the author of many useful experiments, among others, hatching eggs by artificial heat. On meteorology we have a very interesting paper by Wren, pointing out a course of experiments, similar to those since carried out by the British Association, with hints for the improvement of the anemometer and hygrometer. As an artist, his architectural reputation must speak for him, and we have alluded to his eminence in the delineation of objects of natural history, in which he had the patronage of Charles II. In All Souls' College, Oxford, are preserved many of his architectural designs, and also some of his working drawings, doing in the early part of his career everything himself. For the invention of mezzotinto engraving he is one of the claimants, and also for that of many instruments used in drawing. We have yet to speak of his mechanical ingenuity, which was one of his boyish characteristics, having at an early age devised an orrery, which he dedicated to his father, and a double pen, which received the approbation of the Lord Protector Cromwell. In all kinds of what are called mathematical and optical instruments, his ingenuity was, as we have said, prolific, and his skill was ever ready, in the course of the great works in which he was engaged. In a knowledge of mechanical processes, and an acquaintance with the several trades, he had few rivals in his day; as a civil engineer he has also left proofs of his ability. His invention was most ready, like that of Watt too ready; like that great man, too, he rarely pursued his ideas to completion, and was too negligent to put them into a definite form; the best thing that happened to his suggestions was to become the spoil of pirates and plagiarists, to be secretly conveyed to the continent by Oldenburg, or to be appropriated by Hooke. In reference to these failings, we are by no means unwilling to believe, that if Wren were indeed the inventor of mezzotint, that he would be pleased rather than otherwise with its appropriation by a patron so powerful as Prince Rupert. We have now to speak of his literary attainments, for he was the true admirable Crichton. He made his debut with Latin verses above the youthful standard, and we find him noted by Sprat, in after years, as translating Horace into English verse. In Greek, Latin, Italian,[*] French and English, he was well versed, and his Latin and English prose, as displayed in the few fragments left by him, are far purer than was the wont of that day. As an antiquary he has given us specimens of his labours, and it is deeply to be regretted that, with his love of letters and good skill in them, we should have so few memorials of what he was able to do. Such was Wren, a master in every branch of learning, a contributor to its advancement by his example and exertions on every occasion, admired by his contemporaries, and presenting one of the brightest instances of early and diversified talent matured to produce the most distinguished results.

We have now to trace Wren in his career, to see how his valuable acquirements were pressed into the public service. He early received a Gresham professorship, the Savilian professorship at Oxford, and the dignity of Doctor of Law, and distinguished himself in the discharge of his duties. On the return of Charles II., his connexion could not fail to launch him on the full tide of royal and ecclesiastical patronage, and from that period we find his progress rapid. His rooms at Gresham College had become the resort of the Royal Society, and on the incorporation of that body by that patron of science, Charles II., he became one of its chartered fellows, and subsequently for two years its president. In 1663, he received from the munificent Archbishop Sheldon, his first architectural employment, the construction of the theatre at Oxford, for the accommodation of four thousand persons, an enterprise of which he well acquitted himself. He subsequently received a commission from his uncle the Bishop, to build the chapel of Pembroke College, Cambridge; and about the same time was employed to report on the repair of old St. Paul's, his designs for which were fortunately not carried into effect. He was now the Deputy (and de facto) Surveyor General to the King, and in 1665 made an excursion to Paris, where he employed himself in examining the progress of the arts, and the wonders of the prosperous era of Louis le Grand.

We now come to the epoch of Wren's life, which was to consign him to architecture as his chief pursuit—this was brought about by the deplorable fire of London, in 1666, and the consequent necessity for rebuilding the metropolis. Then, as in the recent case of the fresco painting of the Houses of Parliament, the Government had recourse to the continent, and Perrault was invited to superintend the building of the new city, but fortunately could not come. We hope that the rejection of Cornelius will produce no deeper regret than the absence of Perault. After the fire, projects poured in upon the Government for laying out the city upon a regular plan, Hooke and Evelyn sent in theirs, and Wren sent in his. After-experience has perhaps taught us that no permanent evil has resulted from the non-adoption of any one of them. Wren was appointed one of the Commissioners for rebuilding St. Paul's, Surveyor for rebuilding the city, and in 1669, King's Surveyor General, and a weight of duties was imposed upon him, which he managed to discharge, and at the same time not to neglect his scientific pursuits. Not only had he to design nearly all the public buildings, which had been destroyed, but to build and repair palaces elsewhere, to act as a Commissioner of arbitrations, to report on public improvements, to check accounts of all kinds, and to lay out and construct roads and sewers. In laying out the city, we have greatly to admire his regard for the health and cleanliness of the population, the attention he paid to draining, and we may record his opinion against the practice of burying in towns. Ventilation was one of the subjects to which he had turned his attention; and the internal economy of his buildings was not neglected. He it was who aided in the compilation of the rules for the governance of Chelsea Hospital.

In the midst of these labours, in 1672, Wren received the honour of knighthood; and in 1674, married a daughter of Sir John Coghill, and on her death, a daughter of Viscount Fitzwilliam, in the peerage of Ireland. By both wives he left issue. In 1680 and 1681 he was President of the Royal Society. In 1685, in the revolution parliament, he served as member for Plympton, in Devon., and subsequently for New Windsor and Weymouth. Of his parliamentary duties we have no account, but we suppose he was merely put in as a government officer to supply a fagot vote on ministerial questions. It might be worth inquiry whether Sir Christopher voted for the ejection of James II. or not. At any rate, he was a favourite of both William and Anne, the former of whom made him stand godfather to the cloisters and other barbarisms at Hampton Court, of which the King took the responsibility. To testify his obligations to Queen Anne, Sir Christopher placed at Windsor, in 1714, a statute of Prince George of Denmark, the Prince Consort. Among his notabilia, we must observe that he was grand master of the Freemasons, and is by many good authorities considered the founder of that order.

Sir Christopher Wren built St. Paul's, several palaces, many public buildings and works of art, and fifty churches; and he attained at home and abroad the renown of a distinguished philosopher and great artist. In 1718, the Germans having got possession of the English throne, commenced their career of vandalism, by depriving Wren of his Surveyor Generalship in the 86th year of his age, and 49th of his service, an act which met with the execrations of that age, and the contempt of the succeeding. His time and his unimpaired faculties were now devoted to his mathematical works, and his relaxation was yearly to be conveyed to contemplate his great work. In such pursuits he died happy, on the 25th February, 1723, and was honoured with a public funeral, and a sepulchre in his own immortal monument.

Rarely has there been a man, who cared less for the troubles of this world, or who laboured so hard for such trifling remuneration. His salary for superintending the rebuilding of St. Paul's, was £200,

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[*] Birch's History of the Royal Society, Vol. II, p. 72.

"and for this," as the Duchess of Marlborough said, "he was content to be dragged up in a basket three or four times a week." This salary was, however, in the eyes of his owlish brother commissioners too much, so that at one time they stopped half of it, under pretence of obliging him to hasten the completion of the work. Among other persecutions, they forced him against his own opinion to alter the design of his building, to put a balustrade on the outside, and to have the interior of the dome decorated in perishable painting. Wren, nevertheless, notwithstanding his small allowances, did not die poor, he accumulated enough to leave an estate behind him.

As a man of science and of varied attainments, we have said enough to show Wren's greatness; we have now to consider him as an artist; and here we may observe, that of late years there seems as much disposition to underrate Wren, as formerly the contrary bias prevailed. Why this should be we do not well see—why Wren should be tried by another standard than Palladio or Vignola, or Perault and Mansard. This, however, is part of the fashion, we may say, part of the errors, of the day. The gentle madness of the age is to place the height of art in the mechanical copying in milk-and-water colour of some ancient edifice, and Wren's defect was a too general neglect of all rules of art. So far the antipathy is readily accounted for, but it is not on these grounds that the public will be induced to form its decision as to Wren's merits. The public, whatever may be its failings as to technical criticism, whatever may be its lenient tendency to grant magnificence on the promptings of ignorance, has still some claim to exercise the "vox dei" in matters of art, and will not sink, for trifling errors, preponderating merits. The fault of Wren, decidedly, was his unacquaintance with the details of his art, or inattention to them, and in the weighty labours imposed upon him, there is great reason to fear that he too often made his design on the promptings of the moment, without discrimination, and without subsequent correction. His poverty on many occasions, his misplaced luxuriance in others, his want of breadth and repose, weakness of proportions, and disregard of styles, are defects, which, seen unmitigated among his successors, inspire disgust,—but Wren had redeeming qualities. He had the eye of an artist, he had great resources in unrivalled constructive skill, and when he chose, knew equally how to unite the novel, the grand and the picturesque. When, moreover, we consider him in relation to the age in which he lived, the equally flagrant errors of his predecessors and contemporaries, and that his labours in this country were unexampled, he must be acknowledged to be a great name in art. More errors, perhaps, can be detected in a single great work of Wren, than in all the productions of a modern architect, but his superiority remains unimpeached. Thus the last number of Blackwood contains a prodigious mass of nonsense extracted from Macbeth, and yet the merits of that great work of Shakspeare are still unshaken. Many of Wren's faults arise from the attempt after novelty, a sin not too often committed now-a-days; but still "*une belle faute vaut mieux qu'une mediocre beauté*." As to Wren's neglect of the gothic and defacement of it, however we may regret it, it was a creed as orthodox in his day as the persecution of papists, and the concoction of popish plots. Wren was only mad with the rest, but at least he left some specimens of gothic more decent than anything which appeared from his time to that of Horace Walpole. One of his characteristics was a hankering after domes and skylights, which he early manifested in his design for the repair of old St. Paul's. Wren had at his disposal greater means than perhaps any other architect ever possessed, and on the whole, he made a noble use of them; but we cannot observe without regret, that sums much larger than the barn-church Commissioners allow in these days, were frequently expended without producing any effect.

As examples of Wren's most admired works, we may enumerate St. Paul's Cathedral; the steeples of Bow Church; St. Bride's, and St. Magnus the Martyr; Greenwich Hospital; and St. Lawrence, Jewry, Cateaton Street.

Of interiors—St. Stephen, Walbrook; St. Clement's Danes; St. James's, Piccadilly; Trinity College library, Cambridge; St. Mildred's, Bread Street; St. Bride's; St. Mary, Abchurch; and St. Bennet's, Threadneedle Street.

Of the pointed style—St. Dunstan's in the East; St. Michael's, Cornhill; St. Mary, Aldermary; All Souls' College, Oxford; and St. Alban's, Wood Street.

Of constructions—the dome of St. Paul's; the Monument; the spire of St. Dunstan's in the East; the roof of the Sheldonian Theatre; the repair of Chichester Cathedral; the dome of St. Antholin's, Watling Street, &c.

For drawing up these notices, we have availed ourselves of several works, largely of those of Mr. Godwin and Mr. Elmes, but we have felt that the life of Wren is yet to be written. The Parentalia is only a chartulary, and Mr. Elmes' work, however copious, not exhausting the subject, and containing much heterogeneous matter. It is, nevertheless, at present, the only life of Wren, which deserves the name. Mr. Cockerell has long been understood to have turned his attention to this subject; he has in the instance of the engraving before us, exhibited his zeal; his qualifications are generally acknowledged, and he could not, therefore, do a greater service than to execute this long expected task. Among the works to which the reader may refer, are Wren's Parentalia, Elmes' Life of Wren, Godwin and Britton's Churches of London, Britton and Pugin's Public Buildings, London, Ward's Gresham Pofessors, the Useful Knowledge Life of Wren, Chalmer's Biographical Dictionary, &c. Portraits of Wren are to be found in the Royal Society's Collection, the Sheldonian Theatre, and Salters' Hall, and a bust in All Souls' College, Oxford.

On the 26th of July, 1664, the first stone was laid of the Sheldonian Theatre, at Oxford, (No. 58,) completed 1669, the expense of which, was £12,470 11*s*. 1*d*., contributed by the munificent Abp. Sheldon. This is one of the earliest of Wren's works, and the ground plan of it was adopted by him from that of the theatre of Marcellus, at Rome, and so arranged as to receive 4000 persons. The roof, 80 feet by 70, rests upon the side walls without crossbeams, and is one of the first and most admired examples of that practice. In 1800 it was discovered to be in danger of falling, and another roof substituted (for a description and engravings of the roof, see Plot's Oxfordshire, Wren's Parentalia, and Elmes' Wren.)

In 1663, he built the chapel of Pembroke College, Cambridge, at the expense of his uncle Bishop Wren. It is 54 feet long by 24 broad, and 30 feet high. The front is of four Corinthian pilasters.

In 1664, he was employed at Oxford in rebuilding Trinity College. A new court of three sides is among these works, the north side of which was completed in 1667, the west side in 1682, and the south side in 1728. The first stone of the chapel (No. 59), was laid on the 9th July, 1691, and the shell completed at the expense of £2000, contributed by Dr. Bathurst. It is of the Corinthian order.

In 1665, he was called upon to furnish designs for the magnificent Library of Trinity College, Cambridge, (No. 61,) which cost £20,000, and is 200 feet long, 40 feet broad, and 38 high, interior measurement. It has two fronts.

In 1668, he was again employed by Archbishop Sancroft, to build a chapel for Emanuel College, Cambridge. This chapel, including the ante-chapel, is 84 feet long, 30 broad, and 27 high; the floor of marble, and the ceiling richly ornamented in stucco. It was finished in 1677.

In 1668, Wren built the old Custom House, (No. 47,) which was burned down in 1718, being the only one of his buildings, as Elmes remarks, of which, in the course of a long life, he witnessed the destruction, a fortune not always attendant upon architects.

In the same year, he was called upon to report upon the state of the spire of Salisbury Cathedral, which he did in an interesting document.

In 1670, he began Temple Bar, (No. 35,) finished in 1672.

In 1671, he began the Monument, (No. 39,) which was completed in 1677. Its height from the pavement, is 202 feet, (30 feet higher than the column of Antoninus,) and stands on a palladian Pedestal, of 21 feet square, the plinth being 27 feet. The lower diameter of the shaft is 15 feet, and it contains a staircase of black marble of 345 steps.

In 1670, St. Sepulchre's, opposite Newgate, was rebuilt by Wren, finished 1674; but in 1790, it was again repaired, and much of Wren's work effaced.

The celebrated spire of St. Mary-le-Bow, Cheapside, (No. 38,) was begun in 1671, and completed in 1677-8. It is founded on a Roman pavement, commences from the ground, and rises nearly plain to a height above the houses. The Palladian doric doorways on the north and west sides, are considered good examples of that kind of doorway. The tower has a second story, containing on each side a window between four Corinthian pilasters, and is then surmounted by a block cornice and balustrade, and each angle relieved by a pyramidal group of bold scrolls, supporting a vase. Among these rises a circular stylobate, supporting a temple of the same figure, and of the Corinthian order, the cell of which serves to support the lower part of the spire. From the balustrade of the circular temple proceed a series of carved flying buttresses supporting another Corinthian temple, with four porticos of two columns each. On the summit is an obelisk, supporting a large gilt dragon.[*] The interior of the church is divided by arcades into a nave and side ailes. Length 65 feet, breadth 62, height 38.

October 16, 1672, the first stone was laid of St. Stephen's, Walbrook, completed in 1679. (No. 23 and 24.) The body of the church is nearly a parallelogram, divided into ailes. Four rows of Corinthian columns form five unequal ailes, the centre being the largest, and those next the walls on either side the smallest. Within one intercolumniation from the east end, two columns from each of the two centre rows are omitted, and the area thus formed, is covered by an enriched cupola, supported on eight arches, which rise from the entablature of the columns. The columns are raised on plinths the same height as the pews. Inner dimensions—length 82 feet 6 inches, width 59 feet 6 inches, height to the flat ceiling of the side ailes 36 feet, and to the top of the dome 63 feet; internal diameter of the dome 45 feet. The dome is formed of timber and lead. Ralph observes that this church is famous all over Europe. Perhaps Italy itself can produce no modern building that can vie with this in taste and proportion.

St. Michael's, Cornhill, (No. 44,) was begun to be rebuilt in 1672, and its tower in 1722. The body of the church is in the Italian style, and is divided into a nave and ailes by Doric columns and arches supporting a plain groined ceiling. The walls of the church do not form right angles with one another, whence Mr. Godwin infers that Wren availed himself of the old foundations. The length of the church is 87 feet, breadth 60, and height 30. The tower is in the perpendicular style, in imitation of that of Magdalen College, Oxford, and rises to the height of 130 feet.

St. Mary-at-Hill, near the Custom House, was rebuilt in 1672. It is 96 feet long, 60 feet broad, and to the centre of the cupola, within the church 38 feet high. At the west end is an ambulatory. Four Italian doric columns placed within the area support an entablature proceeding from pilasters against the side walls so as to produce a cruciform arrangement of the ceiling. The centre space is covered with a cupola.

In 1673, St. Benedict Fink, Threadneedle Street, (No. 54,) was built. The external walls of this church form a decagon, within which six composite columns form a parallel aile in the centre, and support a small elliptical cupola. The spaces between the columns are arched so as to form a series of recesses round the building, having a singular effect. It is much admired by some of Wren's disciples, but its merits are contested by others. Greater inner diameter 63 feet, lesser 48, height 48. The tower and cupola are now pulled down, and the church is to be refronted as part of the Royal Exchange improvements.

St. Olave, Jewry, begun in 1673, completed in 1676; the length is 78 feet, width 34, height 36. Height of tower to the top of the pinnacles 88 feet. The interior has no architectural claims. It contains the tomb of Alderman Boydell.

St. George, Botolph Lane, (No. 45,) was finished in 1674, and cost £4509 4*s.* 10*d.* It is plain and unpretending. The interior is divided by Corinthian columns four on each side, far apart, into a nave and ailes.

St. Dionis Back Church, Lime Street, built 1674, consists of a nave and two ailes, formed by Ionic columns, supporting what Mr. Godwin calls an ugly entablature and arched ceiling.

On the 21st of June, 1675, the first stone of the cathedral of St. Paul (No. 1) was laid, on December 2nd, 1697, the choir was opened for divine service, and in 35 years the whole edifice was completed, under the direction of one architect and during the rule of one bishop of London. Its cost was £747,954 2*s.* 9*d.* The ground plan of the church is a Latin cross,[*] having lateral projections at the west end of the nave, in order to give width and importance to the west front elevation. The exterior is of two orders, the lower Corinthian, and the upper composite, between which are generally semicircular-headed windows in the lower story and decorated niches above, the whole, except at the east and west ends, crowned with a balustrade, which was forced upon Wren, by his brother commissioners, in opposition to his own opinion. The two orders he was compelled to use, contrary to his first design, being unable to procure Portland stone of more than four feet diameter. At the west end, above a lofty flight of steps, is a double portico of coupled Corinthian columns, twelve in number in the lower, and eight in the upper, terminated by a pediment, in the tympanum of which is sculptured the conversion of St. Paul. At the extremities of the front rise two campanile towers, each adorned with a range of Corinthian columns, and covered with a bell-shaped dome, crowned with a pine-apple. On the pediment are colossal statues of the apostles. The projection of the portico is about 1¾ diameter, but to ensure depth of shadow, the central portion of the front wall of the cathedral is set back 25 feet from the inner face of the columns. The east end of the cathedral is terminated by an apsis, or semi-circular projection. At the junction formed by the nave and choir with the transepts, rises a cylindrical wall slightly inclining inwards towards the top, and from which springs the magnificent dome with the lantern on the summit, surmounted with a gilded ball and cross. The drum of this dome is surrounded with a peristyle of 32 Corinthian columns, rising from a plain basement. The entablature of the columns supports a gallery round the basement of the dome, adorned with a balustrade. The basement presents a series of 32 pilasters, each over the corresponding columns of the peristyle, with windows between them, and over their entablature; from a plinth of two steps, begins the external sweep of the dome. At its summit is a second balcony or gallery, where the lantern commences. The interior contains a nave and two side aisles, formed throughout by massive piers, dividing them from the nave and choir, and adorned with composite pilasters, from the entablature of which spring semicircular pilasters connecting the piers with each other. On the face of each pier towards the nave and choir is a single Corinthian pilaster, nearly equal in height to the under side of the crown of the arches, supporting an entablature which extends throughout the church. Above the latter is an attic story, from which, at certain intervals, springs a semicircular arch, spanning the body of the church, and over each of the spaces which occur between these, the angles being filled with pendentives, rises a small flat cupola from an enriched cornice. In the central portion of the building, over which rises the cupola, are eight solid piers ornamented with pilasters similar to the others; but the openings of the arches are nearly equa lin height to the ceiling of the nave and choir. Above the openings and around the dome extends a bold cornice, forming the floor of the whispering gallery, and bearing an iron railing. The drum of the cupola is adorned with a range of composite pilasters, rising from a plain basement above the gallery, and between which are windows. From the entablature of these pilasters springs the inner dome, and having an opening in the crown in order that it may receive lights from the lantern above. The inner part of the dome is decorated with paintings by Sir James Thornhill, although Wren wished mosaic to have been employed. The dome of the Pantheon it is observed,[*] is no higher within than its diameter; the dome of St. Peter's is two diameters, the one appears too high and the other too low, Wren has taken the mean, showing a concave every way, and lighted by the windows of the upper order. Above the inner dome again, in order to carry the lantern with which the cathedral is adorned, (said to weigh 700 tons,) Wren has introduced a brick cone, two bricks thick, and having every five feet high a course of bricks eighteen inches long, bonding it throughout the entire thickness; and on which is constructed the exterior of the dome, which is chiefly of wood. A want of ornament is observable in the interior, and those introduced are not in good taste, favouring too much of Sir Christopher's studies at Paris. Beneath the whole cathedral is a crypt.

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[*] See an engraving in the 3rd vol. of this *Journal*, p. 329.

[*] History and Description of St. Paul's Cathedral, by George Godwin, Jun., Esq., M.R.S., M.R.I.B.A. London, 1837.

(Note). See engravings in the *Journal*, Vol. III. pp. 329 and 330, and Vol. IV. p. 375.

We may observe here, that some doubt may be expressed as to James II. having interfered to alter the original plan, for in that plan the circular walk round the centre provided amply for processions and the pomp of worship.

The following are the comparative dimensions of St. Peter's and St. Paul's.

	St. Peter's. feet.	St. Paul's. feet.
Length of church and porch .	729[†]	500
Length within . . .	669	500
Breadth within the doors of the porticos . . .	510	240
Breadth at the entrance . .	226	100
Breadth of the front without .	395	180
Breadth at the cross . .	442	223
External diameter of the cupola .	189	145
Inner ditto . . .	139	108
Height from the ground without to to the top of the cross .	437 432	340 330
Height of the church . .	146	110
Height of columns in front .	91	40

In 1675 the Royal Observatory at Greenwich (No. 40) was begun on the site of an ancient tower, and in 1676 it was finished.

In 1675, St. Michael's, Wood Street, (No. 14,) was rebuilt. Its interior forms a large and well lighted parallelogram, with an ornamented coved ceiling. The exterior of the east end presents four Ionic pilasters on a stylobate, supporting an entablature or basement, and having three circular-headed windows in the intercolumniations. Length within 63 feet, breadth 42, height 31. Height of tower, 90 feet.

In 1676, Wren built St. Stephen's, Coleman Street, the interior of which presents nothing remarkable. The length of the church is 75 feet, breadth 35 feet, height 24 feet. Height of tower, 65 feet.

St. Magnus the Martyr, London Bridge, (No. 12,) was built in 1676, and the steeple in 1705. On the top of the square tower, is introduced an octagon lantern, crowned with a cupola and short spire. The interior is divided into a nave and ailes by Ionic columns. The ceiling is camerated. The interior is 90 feet long, 59 broad, and 41 high.

St. Michael's, Bassishaw, was begun in 1676, and finished in 1679, and is a plain, substantial building. The inner dimensions are 70 feet long, 50 feet broad, and 42 feet high. The interior is divided by Corinthian columns into two ailes.

St. Mildred's, Poultry, was built 1676, and presents nothing remarkable in its interior. It cost £4564 9*s.* 7¾*d.* Its length is 56 feet, width 42 feet, and height 36 feet. The height of the tower is 75 feet.

St. James's, Garlickhithe, (No. 57), was begun in 1676 and finished in 1683. The interior consists of a nave and side ailes, formed by Ionic columns on high plinths. The length of the church is 75 feet, breadth 45, and height 40. The height of the tower, 98 feet. The cost of the church was £5357 12*s.* 10*d.*

St. Nicholas Cole Abbey, (No. 31,) Fish Street Hill, was built in 1677. The interior is well proportioned, with Corinthian pilasters against the walls, and the ceiling divided into panels. The interior length is 63 feet, width 43 feet, and height 36 feet. The height of the steeple is 135 feet.

St. Mildred's, Bread Street, was rebuilt between 1677 and 1683. The interior is remarkable as being entirely covered with a large and highly enriched cupola or dome, formed within the external roof by means of slight deal ribs attached to the principal timbers, and lathed and plastered. The length is 62 feet, breadth 36 feet, and height 40 feet.

In 1677, was built St. Mary, Aldermanbury. It is 72 feet long 45 feet broad, and 38 feet high; divided into a nave and ailes, by composite columns, presenting six intercolumniations, and bearing an entablature. The ceiling of the nave is wagon-headed.

St. Michael's, Queenhithe, (Nos. 16 and 25,) was built in 1677, and is 71 feet long, 40 feet broad, 39 feet high, and the tower and spire 135 feet high.

St. Bride's, Fleet Street, (No. 3,) was built in 1680, and cost £11,430. The steeple was completed in 1703, (the first stone having been laid in 1701.) It is 226 feet high. The two lower stories of the spire, which rises from a grand tower, are Tuscan, the third Ionic, and the fourth composite. From this latter springs the tower. The exterior of the east end of the church is neat, and the dressings of the great window in a bold style. The interior of the church is approached by a porch within the tower, and a vestibule beneath the organ gallery. An arcade of coupled Tuscan columns on either side divides the area into nave and ailes. The ceiling is arched. The recess at the east end forming the chancel, is richly decorated. The inner length of the church is 99 feet, breadth 58 feet, and height to the crown of the arch 48 feet 6 inches.[*]

St. Swithin's, London Stone, was built in 1680. The ceiling of the church is formed into an octagon cupola, springing from half columns against the walls, and one whole column before the organ gallery. The church is 61 feet long, 42 wide, and 40 high. Tower and spire 150 feet high.

In 1680, Wren began, and in 1682 finished, the church of St. Clement Danes in the Strand. He contributed his exertions to this building gratuitously. The interior, richly decorated, has a camerated roof, supported with Corinthian columns. The south front of the building has a circular portico of six Ionic columns. The dimensions are, length 96 feet, breadth 63 feet, height 48 feet. The height of the tower is about 116 feet.

St. Anne and St. Agnes, Aldersgate Street, was also built in 1680. The interior, 53 feet by 53 feet, and 35 feet high, is divided into a large square in the centre by four Corinthian columns.

St. Mary Aldermary, Bow Lane, (No. 37,) is in the florid style, and is supposed to be a copy of the old building. It cost £5000, contributed by Henry Rogers, Esq. The interior consists of a nave, two ailes, and a chancel. The bell tower is divided by string courses into four stories, and terminates with an open parapet; the octagon turrets at the four angles are panelled to the whole height, and surmounted with carved finials. The length of the church is 100 feet, breadth 63 feet, height 43 feet. The tower is 27 feet square, and 135 feet high. It was built in 1681.

St. Antholine, Watling Street, (No. 41,) was built in 1682, at an expense of £5700. The interior is covered with an oval shaped dome, worthy of observation. The length of the church is 66 feet, breadth 54 feet, and height 44 feet. The steeple is 154 feet high.

St. Augustine's, Watling Street, (No. 5,) was built in 1682, and finished the 23rd Sept., 1683; the steeple in 1695. The interior is small, divided into a nave and ailes by Ionic columns, bearing a wagon-headed ceiling. The dimensions of the church are 51 feet long, 45 broad, and 30 high.

Chelsea Hospital (No. 48) was begun in 1682, and finished in 1690.

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[*] Library of Useful Knowledge, Life of Wren.

[†] See Mr. Godwin's note on this, p. 47.

[*] See an Engraving in the Journal, vol. 3, p. 329.

It cost £150,000. The principal building consists of a large quadrangle of brick, open on the south side. The east and west wings are each 365 feet in length, measured from the north front. In the centre of the front and each of the wings are pediments of free stone, supported by doric columns. The internal centre is occupied by a vestibule, terminating in a dome, and the whole length of the principal building, from east to west, is 790 feet.

In 1683, Wren was employed to build a palace at Winchester, for the bishop, but a great part of it has since been pulled down.

He was also employed to build a palace in the same city for Charles II., (No. 20,) the foundation stone of which was laid on the 23rd March, 1683, by that monarch. This building was never completed, and the remains are now converted into a barrack. The design for the original palace, is to be found in Milner's Winchester, vol. 1, p. 433.

In 1683, the Ashmolean Museum, at Oxford, was built.

St. Clement's, Eastcheap, was begun in 1683, and finished in 1686, Its interior is a parallelogram, with an aile on the south side, separated from the body of the church, by two columns, of the composite order, rising from very high plinths. The length is 64 feet, breadth 40, height 34. The height of the tower is 88 feet.

In 1683, Wren built the Chapel of Queen's College, Oxford, which is 100 feet long, and 30 broad. The design of the quadrangle, built by Hawksmoor, is also attributed to Wren. Hawksmoor was the pupil of Wren, and his successor as Surveyor for building the fifty new churches under Queen Anne's act. Wren also built at Oxford, the towers and other buildings at All Souls' College, in the pointed style, (Nos. 7 and 8,) and the octagonal bell-tower of Christ Church College, (No. 50,) which is also in the later pointed style, with a lantern and dome, lighted by eight windows.

St. Bennet's Paul's Wharf, (No. 28,) said to be the burial place of Inigo Jones, was rebuilt in 1683. The interior, which is unimportant, is 87 ft. long, 60 feet broad, and 30 feet high.

All-Hallows the Great, Thames Street, was built in 1683. It is remarkable for a carved oak screen. The length of the church is 87 feet, breadth 60 feet, and height 33 feet. The height of the tower is 86 feet.

St. James's, Westminster, (No. 27,) was built in 1683. The exterior, of brick, is plain. In the interior Wren made some exertion; the roof is arched, supported by twelve Corinthian columns, and the ceiling panelled and decorated. The length of the building is 84 feet, breadth 63 feet, height 42 feet. The height of the steeple 149 feet.

The gate of the Temple in Fleet Street was built by Wren in 1684.

St. Martin's, Ludgate, was built in 1684. The tower rises from the ground in the centre of the front, and is surmounted with a spire. The length of the church is 57 feet, breadth 66 feet, height 59 feet. The height of the steeple is 168 feet. The cost of the church, £5378 18*s*. 8*d*.; the interior is formed into a Greek cross by four composite columns, standing on high plinths.

All Hallows', Bread-street (No. 15) is called of the Tuscan order. It is of stone, and was built in 1684, and the steeple in 1697. The length of the church is 72 feet, breadth 35 feet, and height 30 feet. The tower, 86 feet high, is of stone, built square, and decorated; the keystones over the windows being carved heads, and between each a large festoon.

St. Mary Magdalen's, Old Fish Street, was built in 1685. It is a substantial fabric, with a bell-tower at the north-west corner. The south-east and east ends display a series of circular-headed windows, with trusses supporting a continued cornice above. The length of the church is 60 feet, width 48 feet, height 30 feet. The cost was £4291. 12*s*. 9*d*.

St. Benet's, Gracechurch Street, (No. 9,) was built in 1685. It is 60 feet long, 30 feet wide, and 32 feet high. The height of the tower and spire is 149 feet. The cost of the building was £3583 9*s*. 5*d*.

St. Matthew's, Friday Street, (No. 56,) was built in 1685. The east end presents a series of six circular-headed windows on a lofty stylobate, surmounted with a cornice and balustrade. The interior, 60 feet long, 33 feet broad, and 33 ft. high, is plain with a flat ceiling. The height of the tower is 74 feet. The cost of the building was £2381 8*s*. 2*d*.

St. Alban's, Wood Street, (No. 42,) in the later pointed style, was built in 1685, and is a bad restoration of the old building. The length of the church is 66 feet, breadth 59 feet, height 33 feet, and height of the tower 92 feet.

St. Mary's, Abchurch Lane, was rebuilt in 1686. The interior is 65 feet long, 60 feet wide, and 51 feet high, covered with a large and handsome cupola, supported on a modillion cornice, and decorated with paintings by Sir James Thornhill. The height of the tower and spire is 140 ft.

St. Audrews', Holborn (No. 43) was built in 1686. The interior is large. It is divided into a nave and side ailes by pillars carrying a wagon-headed ceiling. The length is 105 feet, breadth 63 feet, and height 43 feet. The height of the tower is 110 feet.

In 1687, Christ Church, Newgate Street, (No. 6,) was begun, and finished in 1704. The interior is divided into a nave and side ailes by small Corinthian columns, supporting a wagon-headed ceiling. The length is 114 feet, breadth 81 feet, and height 38 feet. The height of the steeple is 153 feet. It is a pleasing object at a distance, but is a confused composition, although its parts are well proportioned.

St. Lawrence, Jewry (No. 22), the corner of Cateaton-street, was began 12th April, 1671, and finished 1686. The interior consists of one large area, with an aisle on the north side, formed by Corinthian columns carrying an enriched entablature, standing on a plinth, and supporting a pediment, the inter-columniation being occupied by two windows and a niche. The extreme angles of the front are terminated by pilasters, between which and the columns are other niches. The steeple is 130 feet high.

St. Margaret Pattens, Fenchurch-street (No. 36), built in 1687, consists of a nave and aile, and chancel. The walls are decorated with Corinthian pilasters. The ceiling is flat, having a square of fretwork, and the arches similarly adorned. The length of the church is 66 feet, breadth 52 feet, height 32, and of the tower and spire 198 feet 2 inches.

St. Margaret's, Lothbury (No. 49), was erected in 1690. Consists of a nave, and decorated with Corinthian pilasters, and an aile formed by two columns of the same order. The ceiling is coved. The length is 66 feet, breadth 54 feet, and height 36 feet. The tower and spire 140 feet high.

The church of St. Edmund the King, Lombard-street (No. 51), was also built in 1690. In it was buried, in 1563, Edward Shute, author of a folio called "The First and Chiefe Grounds of Architecture," being one of the first English works on practical architecture. The interior of the church is plain, surmounted with a dome or skylight, but it is well fitted up. The length is 60 feet, width 39 feet, height 33 feet. The height of the tower and spire, which are much ornamented in an incongruous manner, is 90 feet.

St. Andrews of the Wardrobe was built in 1672. The interior is divided by 12 square Tuscan pillars, in two stories, into a nave and ailes, surmounted with a camerated ceiling, formed into panels. The length is 79 feet, breadth 59 feet, and the height 38 feet. The interior is plain. The height of the tower is 86 feet. The cost of the building was £7060 16*s*. 11*d*.

In 1690, the College of Physicians, Newgate-street (No. 52), was finished. It is now converted into a meat market, and the upper part of the theatre into a brass foundry. The anatomical theatre, lighted by a lantern, was well designed for both seeing and hearing.

In 1692 Wren built Morden College at Blackheath (No. 46). It is of brick, with stone quoins and cornices, forming a quadrangle, surrounded with a colonnade. In the interior is a chapel.

In 1694, All Hallows', Lombard-street, was built. The interior is fine, being subdivided, and is 84 feet long, 52 feet broad, and 30 feet high. The tower is 85 feet high, and with the rest of the exterior is quite plain.

St. Mary, Somerset, Thames-street (No. 60), was erected in 1695.

The interior has a flat ceiling, and is divided into a nave and two side ailes, is quite plain. It is 83 feet long, 36 feet broad, and 30 feet high. The tower is square, with barbarous pinnacles, the height to the top of them being 120 feet.

St. Michael's Paternoster Royal, Thames-street (No. 33), was built in 1694, and the spire in 1713. The interior is plain, with a flat ceiling coved at the walls. The length is 86 feet, breadth 48 feet, and height 40 feet. From the tower rises a pleasing tower of two orders, the lower story, Ionic, bearing an entablature and vases. The whole height is 90 feet.

His patroness, Queen Mary II., having died, Wren was employed by William in 1695, to design the mausoleum in Westminster Abbey.

Wren was employed by Queen Mary II. to enlarge the Royal Palace at Greenwich (No. 19), which was subsequently converted into the Marine Hospital. The principal front to the Thames contains the Royal Court, 300 feet square, having on the west the courts of King Charles II. and King William, and on the east that of Queen Anne and Queen Mary, and on the south the great hall and chapel. The court of King Charles II., containing the great end wing, is of Portland stone, and of the Corinthian order. In the middle is a tetrastyle portico, with arcades. At each end is a great pavilion, rising into an attic order, and forming a high tower. The other wing corresponds. The Royal Court contains two colonnades being each 30 feet long, and consisting of 150 columns and pilasters 20 feet high. The great hall in King William's building is 106 feet long, 56 feet wide, and 50 feet high. The painting of it cost £6,685.

St. Vedast, Foster-lane (No. 5), was begun in 1694, and finished in 1698. The interior is divided into a nave and aile by a range of Tuscan columns. The ceiling is flat, and formed into one large panel, enclosing others smaller, and decorated with wreaths of fruit and flowers. The length is 69 feet, breadth 51 feet, height 36 feet. The spire and the top of the square tower are by some admired. It consists of three stories, the lowest presenting four concave faces, with clustered pilasters and piers at the angles. The centre story has four convex stories, with plainer piers; and the third story consists of an obelisk, with scrolls at the corners of the base.

St. Dunstan's in the East (No. 12), was restored by Wren in the pointed style; and in 1698 he built the tower and spire, which are on the plan of the spire of St. Nicholas at Newcastle. The spire is supported on a tower 20 feet wide, by four flying arches. Wren's nave has since been pulled down and rebuilt.

He also repaired the interior of Guildhall.

A theatre built by Wren near Fleet-street, shortly after the restoration, stood upon the site formerly occupied by the New River Company's offices.

At St. James's Palace Wren was also employed. He designed the Doric court, the council chamber, the audience-room, and the dining-room.

Buckingham House, now pulled down was built in 1703 (No. 29).

Marlborough House (No. 17) was begun in 1709.

In 1713, Sir Christopher was employed to repair Westminster Abbey, when among other works he extended the west front (No. 4), and carried the towers up to the height of 225 feet. The design is incongruous, and is far from a happy specimen of his skill in the pointed style.

Mercer's Hall, Cheapside, contains a fine set of rooms and a chapel.

Isleworth church is partly built on a plan designed by Wren.

The new buildings at Hampton Court Palace (No. 30 and 32) were built by Wren in 1690. What are called the king's apartments are 328 feet long, and the queen's apartments, 330.

The house in Cheapside occupied by Mr. Tegg was the Old Mansion House, built by Wren (No 55.)

On the south side of Queen-square, Bloomsbury, was a house built for the Earl of Newcastle.

Near the south-west angle of St. Paul's church-yard is another of his mansions.

Another was in Great Russell-street, Bloomsbury, and also some buildings in Lawrence Pountney Hill (No. 26).

At Chichester, where he very ingeniously repaired the spire of the cathedral (No. 2), are two houses of red brick, with stone architraves, and a Corinthian modillion cornice.

A hunting-palace at Newmarket built for Charles II., was also among his designs.

The entrance and other buildings in Doctors' Commons (No. 34 and 62) is another work.

The counting-house and court-room in Christ's Hospital (No. 10), were built by Command of Charles II.

At Windsor Castle Sir Christopher built the Star Building about 120 feet long, now the Stuart Building. In 1676 he enlarged the North Terrace, and executed other works. A design for an Italian palace is inserted in Wyatville's Illustrations of Windsor Castle.

He was also employed on the repairs of the Tower and other public buildings, and in erecting a number of buildings in the city. It may be further observed that most of his churches are enriched with altar pieces, and carved pulpits and fonts executed under his direction.

DR. PAYERNE AND HIS DIVING-BELL EXPERIMENTS.

An announcement was lately sent forth, with a loud flourish of trumpets, that a discovery had been made of vast importance in all sub-aqueous works, by which man would be enabled to surpass the fishes in their natural element, and to live for an indefinite time without communication with the atmosphere. Dr. Payerne, the alleged discoverer of the new process for decomposing water in quantities sufficient to support animal life by the resulting oxygen, exhibited his prowess in the diving bell at the Polytechnic Institution to the wondering company; and in the presence of several scientific men, remained under water, without any supply of air beyond the contents of the bell, upwards of three hours. The Doctor took down with him a bag, supposed to contain the mysterious apparatus by which he was enabled to generate air for the support of life so long under water, and having accomplished this feat, he was looked upon by the admiring crowd as a water deity, and the newspapers failed not to predict the most important consequences from the discoveries of this modern Neptune. The experiment having been several times repeated in the diving bell of the Polytechnic Institution, it was determined to bring Dr. Payerne's discovery to the test of practical utility in the operations on the wreck of the Royal George at Spithead. Major General Pasley had promised to afford the opportunity; accordingly, on the 2nd ult. the experiment was made, and was subsequently repeated, during which six descents were attempted with various results. A very ample report of the experiments was given in the *Times*, and in a manner which led to the belief that the account was from authority, and had been furnished by some person who took part in the proceedings. The report is too long to copy entire; we must, therefore, be satisfied with a summary of the two days' adventures at Spithead, culling here and there, from the original, passages which evidently show, notwithstanding the care taken to produce an opposite impression, the failure of Dr. Payerne's mysterious apparatus to afford facilities in submarine undertakings, so far at least as these experiments may be considered the test of its value.

In the introductory allusion to Dr. Payerne's previous experiments, it is stated that Major General Pasley, after having witnessed the Doctor's "performances" at the Polytechnic Institution, still entertained great doubts whether the apparatus would be equally efficient at Spithead; "for, "as he told the Doctor," though he was satisfied that he could produce good air at any depth, the pressure of from 12 to 15 fathoms of water at the bottom of the anchorage at Spithead would compress the air in a diving bell so much, that though men might exist in it, they would not be able to work to advantage, being nearly up to their necks in water."

We must suppose that the reporter is here in error, for he represents General Pasley to be egregiously ignorant of the commonest law of pneumatics, and of notorious facts connected with the use of the diving bell. The General must surely have known that if Dr. Payerne could generate any gas with his apparatus, it must become, at the instant of its generation, of the same pressure as the air in the bell, and, to the extent of its volume, expel the water as effectually as air pumped in, or otherwise introduced, under any state of compression. The difficulty which is represented to have been raised by General Pasley was, however, a lucky means of relieving the Doctor from an awkward predicament into which he would otherwise have been placed as soon as the bell was lowered into deep water. The thought suggested itself, that General Pasley's objection might be removed by attaching to the bells *cylinders of highly compressed air.* These cylinders were four in number. Each one was of the capacity of four cubic feet, and the air was compressed to ten atmospheres. The Doctor consequently was provided with an available supply of air, independently of the contents of the bell—and also independently of the "good air" generated in the mysterious box—equal to 160 cubic feet at the pressure of the atmosphere. Notwithstanding this ample provision, General Pasley still had misgivings of the result, the reporter informs us:

"When the preparations were completed, Dr. Payerne took his seat in the diving bell accompanied by Major-General Pasley, *who, having full confidence in the goodness of the Doctor's air, but less in his expedient for keeping out the water from the bottom of the bell, took the precaution of putting on a water-tight diving dress,* offering another to the Doctor, who rejected it, in the belief that he would be able to keep the bell completely dry. *They had, however, scarcely descended more than* 10 *or* 12 *feet below the surface, when the water came in upon them so fast that the Doctor requested that the bell should be hauled up out of the water,* as he said he was sure that it must be leaky."

The fact was as Dr. Payerne suspected. The air escaped from the top of the bell, in consequence of the cap over the air hole not having been screwed down tight. During this first attempt to descend, one of the cylinders of compressed air was exhausted, though the bell had been lowered only twelve feet. It does not appear whether or not Dr. Payerne attempted to use his air-generating apparatus in this experiment. His confidence in his resources was, however, so much shaken by this first adventure, that, before going down a second time, he followed General Pasley's prudent example, and put on a diving dress.

In the second descent they were lowered 12½ fathoms, "*when they were hauled up by mistake of a signal before they had quite reached the bottom.*" The three remaining cylinders of compressed air were exhausted in this descent; the effect of it was so far successful that it kept the water within six inches of the bottom of the bell. Dr. Payerne's assistant and Lieut. Hutchinson next descended, but as they would not wait to have the cylinders refilled, "they were obliged to make the signal to stop lowering after they had only descended 23 ft. the bell being at that time nearly half full of water." Thus the experiments of the first day ended without any result. It does not appear, indeed, that Dr. Payerne or his assistant on these occasions once employed the air-generating apparatus; or if they did, it was certainly of little use.

On the second day, as on the first, there were three descents; two by General Pasley and Doctor Payerne, and one by the Doctor's assistant and Lieutenant Hutchinson. As these were the most important trials, we will give the account of them in the reporters' words:—

"Dr. Payerne and Major-General Pasley went down twice—first to the depth of 12½ fathoms, when they were pulled up by mistake of a signal before they reached the bottom, to their great disappointment. After the four cylinders were filled again with compressed air, which was done in about an hour, they descended a second time, and as the men above had strict orders not to stop lowering until the diving bell reached the bottom, and not to haul it up again, unless they pulled the signal line three or four times, Dr. Payerne had the satisfaction of getting a small piece of wood from the wreck of the Royal George, after which they made the signal to ascend. Another experiment, of still greater interest, was tried at the suggestion of Lieutenant Hutchinson, who went down without any air cylinders, accompanied by Mr. Hardiman, having the end of one of the diver's air-pipes with them, through which air was forced into the bottom of the diving-bell by one of the small pumps which usually supplies air for a helmet-diver. By means of this pump the water was expelled from the lower part of the diving-bell, and replaced by condensed air, which enabled them to descend to the very bottom, there being no cylinders to prevent the bell from taking the ground, as in the former experiment; and Mr. Hardiman also brought up some small relics from the wreck.

"The result of these experiments is, that both Major-General Pasley and Lieutenant Hutchinson expressed their high opinion of the merit of Dr. Payerne's invention, as applied to the diving-bell; for they considered that the air they breathed in the bell was perfectly good; and the whole apparatus for purifying it was contained in a case not larger than a common portable writing-desk, which gives no trouble but that of turning a small winch or handle occasionally, and as, besides water, two very cheap and simple ingredients only are used, the manipulation requires no science on the part of the person in charge; and, when the diving-bell is once filled with compressed air, either by letting it escape from vessels previously filled with it, as in the first experiment, or by four men pumping for less than half hour, as in the second experiment, no more pumping is necessary, as the air in the bell never requires to be changed."

After carefully perusing the detailed accounts of Dr. Payerne's operations under water, we entertain a very different opinion of the merit of his invention from that which is stated to have been expressed by General Pasley and Lieutenant Hutchinson. We shall now proceed to state the reasons which induce us to look sceptically on the Doctor's apparatus, and to show, from well known facts, that whatever may be its capabilities for generating vital air, he has hitherto effected nothing with it which might not have been accomplished without any apparatus whatever, or by means that have been long known.

It has been ascertained that one gallon of air will support the life of man, when the same air is inspired and expired, about one minute. In a diving-bell which contained 60 gallons of air, a man should therefore be able to support life under water, without any additional supply of air for one hour. The capacity of the diving-bell at the Polytechnic Institution, which will hold six persons, is about 140 cubic feet; which is equal to 870 gallons. This quantity of air ought therefore to sustain the life of one man for fourteen hours. The effect of breathing vitiated air for so long a time would, however, be most probably very injurious, consequently though a person introduced in such air might continue to live for some time, it might not be capable of continuing to sustain the life of one who had been for hours enduring a gradually vitiating air. But we may safely assume that a man with a supply of 140 cubic feet of air might continue under water without much inconvenience for at least four hours. Here then we have a sufficient solution of Dr. Payerne's mystery, without seeking to extract the secrets of the "box." Whatever latent virtue it may contain, it is clear that the Doctor might have managed well enough without its development in the diving-bell of the Polytechnic Institution, where he remained under water in his most successful experiments, three hours and a half. That he did not accomplish more than could be effected by others was afterwards proved most conclusively. Two persons, subsequently to the Doctor's experiments, determined to try how long they could remain in the bell without additional supply of air; and without the aid of any box or any apparatus whatever, they remained under water for *an hour and a half,* during a great part of which time they *burned a light.* The consumption of oxygen gas by two persons and a burning candle for one hour and a half, must have been at least equal to Dr. Payerne's single consumption for three hours and a half. It is clear, therefore, that whatever advantage he might have derived from the superior purity of the air (if any) manufactured by his apparatus, he did not with its aid, and though he had greater inducement to suffer inconvenience, remain longer under water than any other person might have done.

Of the experiments at Spithead, viewed as a test of Dr.

Payerne's invention, little need be said. They were, with one exception, decided failures; and even in the experiment which was most successful, the whole achievement consisted in bringing up a small piece of the wreck of the Royal George, to prove the divers had actually reached the bottom. This was the mighty result of the new discovery which, as announced, was to enable man to dwell with ease at the bottom of the ocean, and to inhale water for air!

Let us examine the means by which this feat was accomplished, to see whether, trifling as it was, any part of it can be reasonably assigned to the operations of Dr. Payerne's box and materials. We are not informed of the size of the bell employed by General Pasley, but from the circumstance of its being constructed of wrought iron, and made expressly to carry on the operations against the wreck of the Royal George, we must conclude that it was at least of the size of those formerly employed by Dr. Halley and Mr. Smeaton, which contained 60 cubic feet of air. The cylinders of compressed air, we have already stated, would furnish a further supply of 160 cubic feet of the pressure of the atmosphere. The two divers would, therefore, have a supply of air equal to 220 cubic feet. With this supply they might have remained under water, if consuming but one gallon per minute, for ten hours; but estimating the quantity of air requisite to sustain life without much inconvenience, from actual experiment at the Polytechnic Institution, we will take it at two hours and a half.

How long they did remain below each time, the reporter fails to state, but it would appear that the bell was drawn up nearly as soon as it reached the bottom; therefore, we may presume the longest experiment did not last more than half an hour. Consequently there could not have been occasion for the Doctor to have generated more air than the supply he took down; and however simple and easy the manipulation of the apparatus may be, he might have saved himself the trouble of turning the handle of the box. Another question arises, if the Doctor did generate any gas *what became of it?* It is known that the volume of air expired from the lungs is very nearly equal to the quantity inspired, and we find that even with the whole supply of air from the cylinders, the water was still six inches within the bell. This could not have been, had any quantity of gas been generated, for it must have expelled all the water and forced itself out of the bell.

The *naiveté* with which the authorised reporter records the success of the last experiment at Spithead, is extremely amusing. Lieutenant Hutchinson and Dr. Payerne's assistant descended *with an air-pipe supplied by a small air-pump,* and with this they appear to have been more successful than was Dr. Payerne with his cylinders of compressed air, and his mysterious box. This mode of descending in the diving bell, which is called in the report "an experiment of still greater interest" than any previously attempted, it will be at once perceived is the plan first adopted by Smeaton, and since generally adopted; the only variation being that the pipe was smaller, and was taken down in the bell instead of being inserted in the top. It thus appears to be admitted, that so far as the experiments extended, the old plan is more advantageous and much less troublesome than the new invention, which was so extravagantly puffed.

As Dr. Payerne does not disclose the process by which he professes to be able to decompose water in sufficient quantities to supply oxygen gas for respiration, it would be useless to speculate on the practicability, if any such plan were applied to works under water. So far as his experiments have gone, they have, we conceive, proved nothing. The Doctor exhibits a mysterious box; he professes to have in it two simple and cheap materials, which are sufficient to generate air sufficient to support life for an indefinite time; he tries its powers, and the effects produced are no greater than if the box and materials had no existence. Were we to speculate respecting the contents of such a box we might imagine it to contain highly compressed oxygen gas. Fifteen cubic feet of gas might be compressed into a case the size of a portable writing desk; and as one cubic foot of oxygen would support life nearly five times as long as atmospheric air, he would thus carry under his arm a supply equal to 75 cubic feet of common air. This speculation, however, can scarcely be correct, or the Doctor's mysterious box would have been more efficacious than it proved.

Though Dr. Payerne's experiments have, we consider, entirely failed to show that he possesses any peculiar art of transmuting water into air, they have been productive of advantages by proving that operations under water may be conducted with a much smaller supply of air than has hitherto been considered necessary.

The great publicity which Dr. Payerne has succeeded in giving to his claims to be the discoverer of an important scientific principle, challenges examination, and has induced us to bestow this notice on his experiments. It would be presumptuous to assert that the Doctor has made no such discovery, but if he have, he has been most unfortunate in his mode of announcing it to the world; for whilst claiming to be a philosopher, he assumes the garb of a charlatan.

FIRE-PROOF BUILDINGS.

Sir—The constant danger and frequent loss to merchants, solicitors, and others, through the destruction by fire of the papers and documents entrusted to their care, has induced my clients to erect an extensive range of "fire-proof" chambers and offices in the Old Jewry, City. At this time some description of the method adopted, viz. of omitting timber, and of using cast iron girders and brick arches to carry the floors, whereby each room becomes in a manner an arched vault, may not be unacceptable to your readers, although the idea is not new, the more especially as many professional men, engaged, as they stated, on somewhat similar works, have inspected the buildings and sketched the details, for the purpose of obtaining information respecting the construction.

Fig. 1. Elevation of iron Girder.

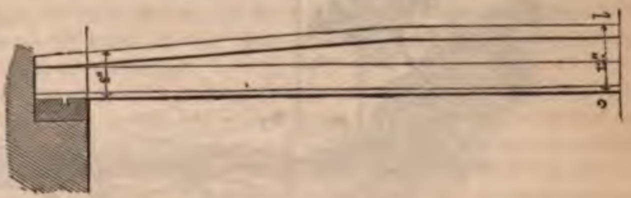


Fig. 2 Looking upwards.

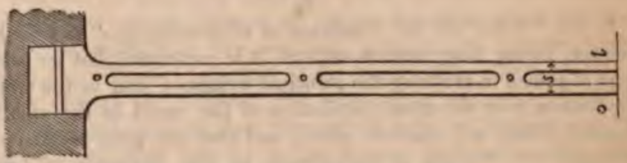
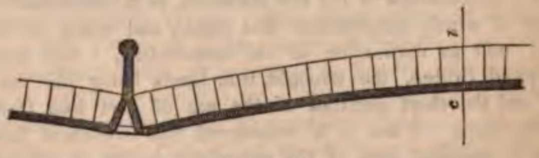


Fig 3. Section of Girder and Arches.



c l, centre line.

The walls are built without any bond plates, instead of which, in the height of each story, according to the height of it, 5 or 6 courses of wrought iron hooping $1\frac{1}{2} \times \frac{1}{8}$ in. is laid in the walls; it must be laid quite flat, and well lapped together or bound round a brick at the joinings and passings. The hooping was tarred and sanded for better adhesion to the mortar, and kept in about an inch from the face of the wall, as the rust would otherwise stain the plastering.

The girders were of various lengths, from 11 ft. up to 18 ft. 6 in. clear bearing; they rested 9 in. at each end on 4 in. York templates, and were placed 7 ft. apart from centre to centre. The girders explained by the diagram were for 15 feet bearings, 12 in. deep in the centre, and 8 in. at the ends, and $1\frac{1}{8}$ in. thick in the centre; the forked or divided parts were each $\frac{11}{16}$ thick, and the roll at the top $2\frac{1}{2}$ in. diameter. They were proved to 26 tons by 13 tons in the centre, although there is not a probability of their having to carry 9 tons, but the object was to give confidence to the public; the deflexion was an inch. The skew-backs were cast hollow, having stiffening pieces about 3 ft. apart, as shown by the plan and section.

Between the girders arches were turned in half a brick in cement, care being taken in setting out the work to bring in the courses with very close joints, and so as for the bricks to touch each other at the lower side; the 5 or 6 centre courses were put in without cement, so as to get jammed in tight, after which they were grouted. The rise of the arch was 5 inches, the spandrils were not filled in, and the bricks were well soaked in water.

The centreing was in all cases held up or suspended to the girders by iron hangers, whereby the weight was gradually placed upon it; this would not have been the case if the centreing had been put up on props and afterwards struck in the common way.

About 22,000 feet of these arches have been turned, and not the slightest appearance of a settlement is to be found in any part of them. The floors over the arches are formed in the usual manner, with joists and sleepers. The intrados are plastered, and a soffit with papier maché work is fixed to the underside of the girders to conceal them.

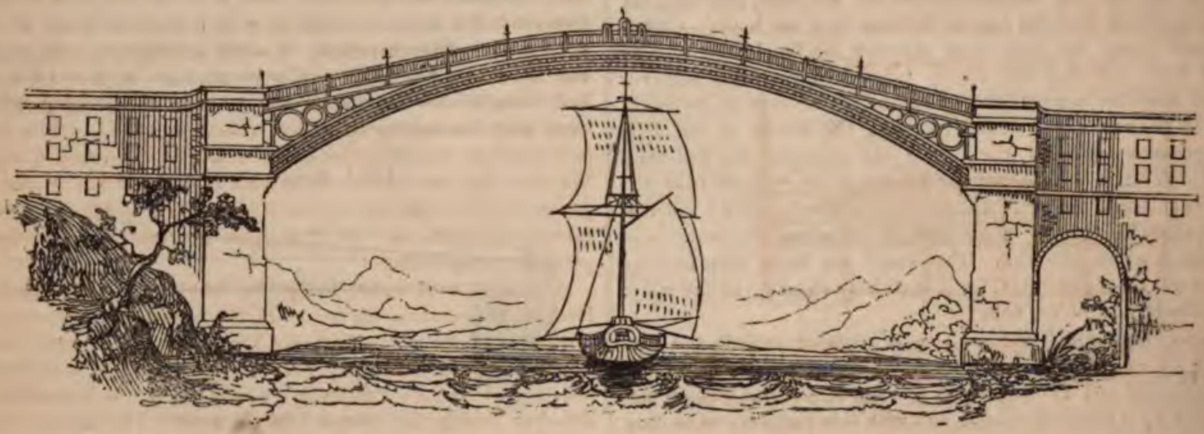
The reliance to be placed on this method of building as a security against the extension of fire from room to room, has been fully tested in the following manner; a large coke fire was made in the centre of each room on the basement floor (which is only 8 feet high) in order to dry the plastering, &c., and although the heat was kept up intensely strong on many successive days, yet it had no worse effect than to make the floor boards, in only two cases out of eighteen, of the rooms over, swell a little so as to be barely perceptible, and that was evidently caused by the quantity of steam driven through from the wet plastering of the arches and walls below.

I am, Sir,
Your obedient servant,
CHARLES DYER.

36, *Guildford Street*,
September 2, 1842.

NOTES ON THE CONSTRUCTION OF BRIDGES.

Description of SUNDERLAND IRON BRIDGE, *with remarks on its construction, and why it has not been more adopted.*



In the "Notes on the Construction of Iron Bridges" in your July number, among other matters noticed, it is contended that no advantage is gained in confining the principal weight of iron in the arch at the bottom, over the equal distribution of the metal in the arch, the spandril filling and roadway bearer, and that the great elasticity of wrought iron renders it inapplicable to the purposes of bridge building. The former remark is fully confirmed, and the latter obviated by a combination of the two materials, as in Sunderland Bridge, a sketch of which accompanies this paper, and which for sake of brevity, and as distinction of its construction, I will name the Vertebrated Bridge, the wrought iron bands being like the spinal chord, and the short portions of the arc of cast iron framework being the bones. When it is considered that in each of these ribs, there is a sectional area of $13\frac{1}{2}$ superficial inches of wrought iron employed, whose power of resistance to compression is within an eighth of being twice as much as cast iron, the utility of this mode of construction over that wholly of cast iron must be self-evident, and moreover, the time since the erection of the bridge under consideration proves its practical durability.*

Should the system of a combination of the two materials be fully carried out, by making the bars of wrought iron radiate from the crown of the arch so as to fill up the whole of the spandril, as in the case with the filling in of the spandril of Chepstow Bridge (a plate of which is given in Weale's Bridges), I have no doubt of the feasibility of extending an arch of this description to the extent of 500 feet, an extent proposed by Telford for the bridge over the Menai Straits, or of 600 feet, as proposed over the Thames by the same engineer.

Mr. Rennie's experiment on Southwark Bridge (see Journal, vol. 3, 1840, page 133) proves that the dilation and contraction of the metal is no impediment, being in that structure only $\frac{1}{40}$ of an inch for an alteration of temperature of 1° of Fahrenheit, and the whole contraction of iron from a fluid to a solid state being $\frac{1}{100}$ as stated by Mr. Edwards, in his account of the Pont du Carrousel in Journal, for last August, page 279.

I must now return to the subject at the head of the paper, and commence with its history. So early as 1790, Rowland Burdon Esq., conceived the idea of throwing an arch of cast iron over the Wear, at Sunderland, for which purpose an Act of Parliament was obtained in 1792. The foundation stone was laid September 24th, 1793, and the bridge opened August, 1796. The quantity of iron in the structure is 260 tons, of which 46 tons are wrought iron. The novelty of the plan adopted on the suggestion of Mr. Burdon, consisted in retaining, with the use of a metallic material, the usual form and principle of the stone arch, by the subdivision of the iron into blocks, answering to the stone of the common arch. These blocks, Figs. 1 and 2, are of cast iron, 5 feet in depth and 4 inches in thickness; each block has

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* The use of wrought iron in connexion with bridgework, is shown in Mr. Brunel's arch, described in Journal, vol. 1, 1838, page 119, which contained no less than 54 pieces of hoop iron, 1 inch broad, by $\frac{1}{16}$ thick, interspersed between the joints.

Fig. 2.

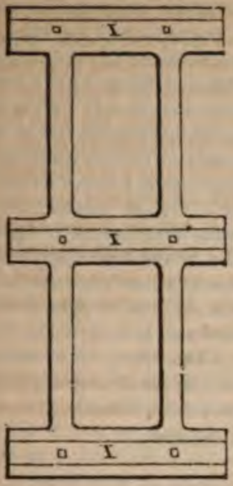
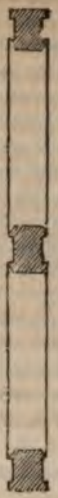
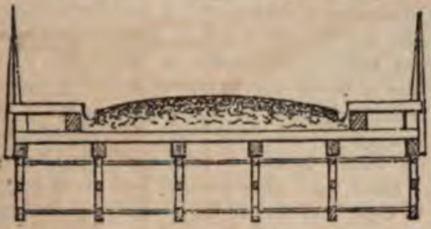


Fig. 1.



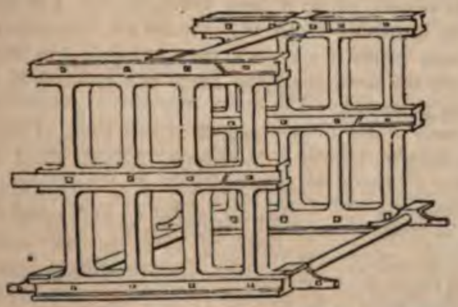
three arms, and forms part of a circle, the middle arm is 2 ft. in length, the other two in proportion; on each side of the arms are flat grooves 4¾ of an inch deep and 3 in. broad, into which are inserted bars of wrought iron, which connect the blocks with each other; they are secured thereto with square bolts driven through the shoulders and arms of the blocks and the bar iron, and are fastened by coterels or forelocks.

Fig. 3. Section of Roadway and Ribs.



The blocks are cast in one piece, but their construction is more easily explained by supposing them to be formed of bars, each block will then appear to consist of three horizontal and two vertical bars; the former cross the latter at the extremities and in the centre; there is a perforation left both above and below the centre crossing, and the vertical pieces cross the horizontal ones at a distance of 5 inches inwards from their extremities; another perforation occurs when two blocks are banded together; these perforations diminish the weight of the fabric very much, when compared with a solid arch. Fig. 4, is a perspective view showing two of these blocks united, and also a portion of two of the ribs bolted together with horizontal bolts which also form stays.

Fig. 5.



The whole structure consists of 6 ribs placed 6 feet apart, each containing 105 of these blocks, built on each other, like the voussoir of a stone arch. The abutments are of stone 24 feet thick, 42 feet in breadth at bottom, and 37 feet at top. The span of the arch is 236 feet, with a versed sine or rise of 34 feet. The height to the soffit from low water mark is 100 feet. The spandrils of the arch are filled in with iron circles, diminishing from the abutment to the centre; the superstructure is of timber, planked over, supporting the carriage road, formed of marl, gravel and limestone. The total breadth is 32 feet, with footpaths of flags, and enclosed by an iron pallisade. The whole structure was put together and thrown over the river in the short period of 10 days, without interrupting the navigation, the centre being supported in two places by gearing or frames of woodwork resting upon piles driven into the bed of the river. The whole expense was £26,000, of which £22,000 was subscribed by R. Burdon, Esq., and secured at 5 per cent on the tolls. In the centre of the pallisade on each side is a cast iron panel, with the inscription "*Nil desperandum, auspice deo.*" The bridge is free on entering the town, and ½*d.* toll is paid in recrossing or leaving the town.

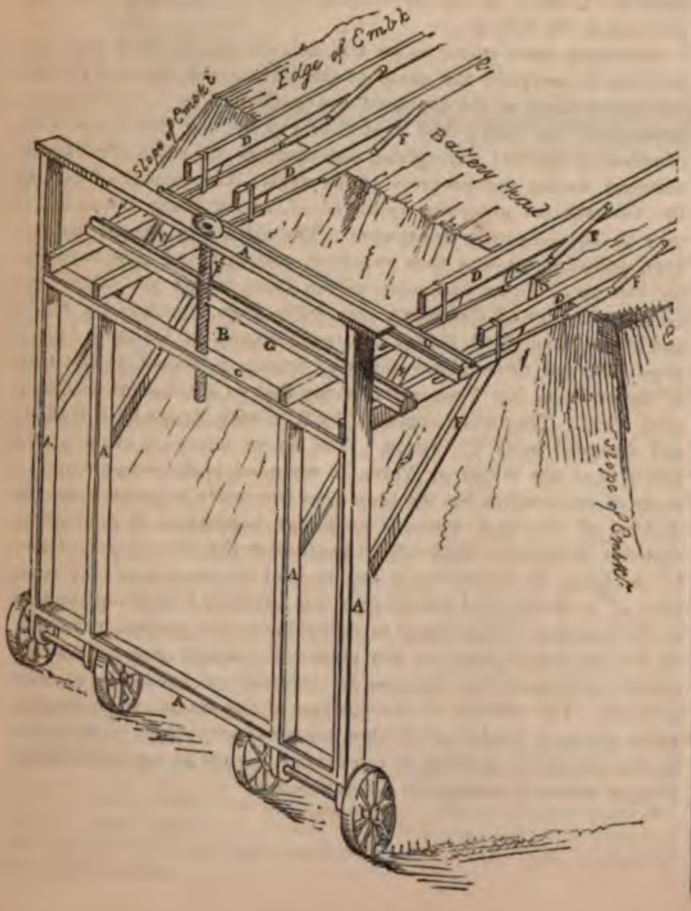
Mr. Thomas Wilson, of Bishopwearmouth, was the engineer, who was also engineer for a bridge at Staines, on the Thames. Mr. Wilson, in conjunction with Mr. Burdon and Mr. Scarth, took out a patent for this mode of construction, and erected a bridge at Yarm, with less success, as the following account will show. The foundation stone was laid September 3, 1803. The iron was commenced to be laid across September 3, 1804, and the arch completed in 8 days. The arch was cast at the foundry of Messrs. Walker of Rotherham. The form was a circular segment, 180 feet span, 27 feet broad between the pallisades, with a 21 feet carriage road; it was composed of 6 ribs, each containing 39 perforated blocks of cast iron 4 feet deep and 4 inches thick. The whole weight, including pallisades, was 250 tons. The abutments were of stone 30 feet thick, and the flank walls 50 feet long from back of abutments, 7 feet in thickness at base, and diminishing by 6-inch offsets to 4 feet. The height of parapet walls including fascia 4½ feet. The contractors were, Mr. Wheldon for the stonework, amount £2440, and Mr. Wilson, the engineer, for the ironwork, amount £5660. The bridge fell at midnight, January 12, 1806. It had been open for foot passengers some time previous to the falling.

Architects were called in by the magistrates of Yorkshire and Durham to ascertain the cause of the falling, who reported that the internal masonry of the abutment was insufficient to resist the lateral pressure of the arch; they were clearly of opinion that this was the occasion of its fall; a complaint was made to the same effect by the surveyor during the progress of the work. The manner of placing the ribs was not generally approved of, as not being calculated to take an equal bearing or pressure. The old bridge, which had not been pulled down, was then repaired, widened, and substituted for the iron one. These particulars of the Yarm bridge are taken from Grave's History of Cleveland, pub. 1808, page 68, appendix No. 1, and of the Sunderland Bridge, Surtees' History of Durham, vol. 1, page 227, and three plates now very scarce, published at the time of the erection, but I am sorry to say that no letter-press accompanied them. They were engraved by R. Clarke, drawn by J. Raffield and designed by G. T. Wilson. The above untoward event of the falling in of the bridge at Yarm, in my mind, is the reason why this mode of construction has not been more frequently employed, and the distrust of iron as a material for bridge building, as it will be seen that this bridge was built only 21 years after the introduction of iron for bridges. In conclusion, I beg to offer to you, at least, the novel idea of rendering cast iron bridges less brittle by submitting the iron to the process of annealing or to assimilate it by a gradual reduction of its temperature, more to the nature of wrought iron, which appears to me would also increase its capability of resistance to compression. The division of the portions of the arc into short lengths, as the blocks in Sunderland Bridge, has great advantages in providing for the expansion, as when so subdivided it is not so much felt, being divided insensibly among the different joints.

NOTES ON EARTH-WORK.

Account of a Machine called a Tippler, *used on the Southampton Railway.*

To the most casual observer it must be apparent that the limitation of the quantity of earth-work capable of being executed in one day, occurs at the battery or tiphead, and not at the face of the cutting. The excavation being almost unlimited, whereas the width of embankment limits the teaming, the greatest number of men that can be employed at one tip, being from 10 to 12, and the maximum quantity teamed in one day, being 800 wagons, and for the twenty-four hours, 1000 wagons. Side wagons from quitting their load at the side, are much used to facilitate tipping, and the return of the empty wagons from the battery to the excavation. Of the many attempts made to facilitate this operation, one of the first was used on the Carlisle and the Hartlepool railways, by Mr. Grahamsley; and the following testimony will shew the importance in which the attempt was held by the profession. Mr. Vignoles sent a man to the Carlisle line, who reported that it was not worth adopting; Mr. R. Stephenson sent Mr. Copeland and Mr. Noel, contractors, to the Hartlepool line, for the same purpose; both reported it would not answer; Mr. Locke said that if found practicable, it must be for the interest of the contractor to adopt it, finally I believe it was not found to answer. Mr. Buck tried another plan on the London and Birmingham Railway at Watford, viz. projecting balks of timber over the tip, and after the first wagon was teamed, it was pushed forward until a second was tipped, and both returned together; it became useless on new embankment, and was abandoned. The ordinary disposition of temporary roads is generally as follows, viz. two lines of road are laid down called the empty and full line, and where the battery head is approached, the road diverges into branches or spurrings to as many teaming places as the breadth of the embankment will allow: a horse being employed to draw the empty wagons into a siding, until a full set is empty, and to run the full wagons out of the full siding to the tip head. I have not seen any plan of Grahamsley's machine, excepting the account given in evidence on the Southampton Railway in the Appendix to Brees' Railway Practice. The accompanying sketch is made from a rough sketch sent me by a friend who saw the tippler in operation. The frame A in front, which is perpendicular and supported on two trucks with iron wheels, is provided with a screw B, to raise or lower the cross rail *c*, to suit the inequalities of the ground. The four balks D are in the direction of the railway; one end of the balks rests upon the brackets E and the cross rail *c*, the other ends are supported on the embankment already formed; these balks are for supporting the rails of the full and empty roads; the balks D are tied to the brackets F with wrought iron ties jointed; the two transverse balks with rails G are to support a low truck, having rails laid on the top on a level, and in the same direction as the rails of the two roads, the full and empty: so by a side motion the low truck tranfers a wagon on the top from one line of rails to the other parallel to it, thereby avoiding the delay of horsing as described above. A very similar arrangement is shown in the Journal, Vol. IV, p. 250, in the description of the Paris and Versailles Railway, for the purpose of saving the expence of a turntable opposite each pair ef rails, for transferring the carriages from one line of rails to another. I may also mention that a precisely similar plan is in use at the Nottingham station of the Midland Counties Railway. There being no account published of this machine, perhaps your doing so may elicit further particulars, although there is not much facility given to publish failures.



Yours truly,

St. Anne's, Newcastle-on-Tyne. O. T.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XLI.

> " I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. If it was the intention of the architect of the Alliance Office to show how completely an order may be made to lose its character, not by any alteration of, or 'tampering with' its proportions or details, but by perverse and tasteless application of it—he must be allowed to have succeeded admirably. With the Bank immediately facing his own building, he has ventured to make use of the very same order, so introduced, that every point of difference is most decidedly for the worst. Instead of being placed upon a simple stylobate, the columns are raised upon a basement, of such exceedingly poor and ordinary design in itself, that were all the rest perfectly unexceptionable, the lower part of the building would greatly detract from the general effect. As it is, however, the insignificance and anti-classical taste there displayed, is of little consequence, for the upper part of the façade is also poor; therefore, so far, the whole would be tolerably of a piece, where it not that what is of excellent quality in itself, has been dragged in so as to lose its own value, without conferring any on the other parts. That the columns have been forcibly dragged into the design is evident enough, for not only are they introduced without motive, but quite contrary to it; and in such manner, as to occasion glaring and offensive improprieties. It must be confessed, that in the opposite façade of the Bank, columns are employed only for the sake of effect; but then, there they do produce effect—effect of a more than ordinarily picturesque and tasteful kind. There is nothing that interferes with them, or to mar the gracefulness of columnar composition—in which so very much depends upon that sort of proportion, which is, as often as not, wholly disregarded by those who affect to be most scrupulous as to proportions of detail. The architect of the Alliance Office, for one, has certainly not attended to the proportion alluded to, for he has put his columns so far apart, that they serve chiefly to produce a straggling effect; and yet, owing to the windows between them, the whole has a very disagreeable, crowded, and squeezed up appearance. The centre intercolumn, containing two treple windows, one over the other—an arragement which it is hardly possible by any means to render tolerable, is so wide, as to amount almost to a gap in the composition. Of course this was occasioned by the gateway below, which is in itself so wide, that it also forms a gap, and seems to require columns to support its lintel or architrave; therefore, unless intended for carriages to pass through—which does not appear to be the case, had the opening been a little contracted by two columns being placed so as just to clear the piers, the effect would so far have been better, and the passage through the building would have been just as wide as at present.

II. Professor Hosking is not the only one who has expressed a very contemptuous opinion of Vitruvius; for a writer in the "Annales des Batimens" has spoken of that "venerable authority" in terms that must make his admireas absolutely shudder. He does not scruple to apply to the "Father of

Architecture" and its legislator, the character of "Le plus credule et le plus ignorant des compilateurs"! consequently, if such be his opinion of the idol, we may take it for granted that he entertains no great respect for the intelligence shown by the worshippers of it—by Vitruvius' translators and commentators, or any of those who look to his writings as oracles. It may, however, be suspected that a very great many who have the name of Vitruvius always in their mouths, know very little of his writings, and would be strangely perplexed if asked to explain what they had learned from them, or in what way the study of them has conduced to more enlightened views of the art. Far easier would it be to show how such study has cramped architecture, and has tended to render it a plodding pedantical system, governed not by principles and artistical feeling, but by merely conventional rules—by rules which, if implicitly followed. without regard to the circumstances of the particular case, may operate most injuriously.

III. In architectural history, it is almost invariably the practice to make a full stop at the very point where preceding writers have left the subject, and from which it is most of all desirable that it should be taken up afresh, and carried onwards. From the commencement of the 18th century, everything in the shape of a connected history of the art ceases. What information relative to it is to be obtained at all, is scattered about in fragments through numerous publications, either literary or graphic; nor has any one yet thought it worth while to collect and arrange, to add to and extend such materials, and work them up into consistency and shape. Almost might it be supposed that the art was now altogether extinct, and that since the period above-mentioned, scarcely anything above the feeblest mediocrity has been produced; things

"Too vile to praise, too decent to be damned;"

albeit some of them have been puffed off in their day as first-rate, classical, and everything else that is excellent.

Even a mere matter-of-fact chronicle would be serviceable in its way though immeasurably short of a critical history, which, by fearlessly pointing out the errors of the past, might lead to improvement for the future. So long as there was no Royal Institute, there was little hope of architecture receiving that attention to which—whether justly so or not—it is supposed to be entitled as an artistic, intellectual, and æsthetic pursuit; and since the Institute has been established, there is not one ray of hope more; therefore, even less hope than ever of such proving the case. Sorry I am to say that the Institute seems to be quite satisfied with having got the pap of Royal *patronage*—which I suspect to be worth about as much as Don Armado's remuneration.

IV. Putting aside elementary or technical works, there has of late been a strange dearth of architectural publications in this country, which, to whatever else it may be owing, can hardly be attributed to the paucity of buildings erected within the present century—many of them of a kind too, which, let them be what they may, are of considerable pretension, and ought, therefore to be well-worth studying for their design and the taste exhibited in them. Undoubtedly no immediate, nor very tangible advantage would be derived from the publication of their works to the actual authors of them. Those who have shown the greatest ability, have, least of all, occasion to advertise themselves and their productions; and as an affair of pounds, shillings, and pence, they show their prudence by not doing what they might in the end be out of pocket by. But then, on the other hand, those who have done the most and the best, can generally very well afford so to tax themselves—if only for the sake of showing that they have aimed at something more than professional emolument; and that while they look back on their productions with the feelings of artists, they also look forward to extended fame from them, and that not merely at home, but wherever the art is cultivated. Would the names of Schinkel and Klenze have been already so well known in this country—and, indeed, throughout all Europe, had not their designs been published? Hardly; at least, had they not been so given to the world, comparatively few would be able to judge what they really are. or to profit by the studies they afford, and the ideas they haply may suggest to other minds. This last circumstance, by-the-bye, is one of greater importance than is generally conceived: collections of architectural designs seemed to be looked upon by most persons—not excluding professional ones, as little better than books of patterns, of no other use than as something may be copied out of them at once. Hence, not only the open plagiarism which in any other would be stigmatised as disrespectful, but frequently the vilest botching also. Wide, indeed, is the difference between taking something out of another man's design, and seizing hold of an idea suggested by what may there be shown, which idea, so far from being borrowed may be altogether so different from anything shown in what gave rise to it, as to render it impossible for any one to trace it to its *punctum saliens.*

MARTIN'S CEMENT.

In our last number we slightly alluded to the above cement; since then we have been able to obtain some additional particulars, which we now lay before our readers.

The common qualities of the cement are noticed in the circular in general terms, and the method of working it for common purposes explicitly laid down. It is, therefore, only necessary for us to point out here its various applications.

First, then, *Floors.* These are formed with the cement laid on a bed of concrete or arching. The cement is mixed with fine river sand, or with tile dust or puzzolana, as may be most liked, and laid on the concrete about ¾ inch thick. If Portland or Bath stone is wished to be imitated, the grit is mixed with the cement. After being properly trowelled, it is jointed to imitate stone. If, however, an ornamental floor is wished, a ground work of cement and sand is laid upon the concrete about ¾ inch thick; colours are then mixed (dry) with the cement, and the floor may be laid either to represent octagonal tiles or alternate squares as may be desired in any colour and any pattern. If an inlaid border should be preferred, the pattern is cast in slabs, and the colours let in the spaces left according to the design. Some elaborate mosaic in imitation of tiles found in one of the courts of the Alhambra, the colors of which are blue, white, and burnt sienna, and the size about eight inches wide, can be executed (as they have been already) at about 2*s.* 3*d.* per foot run. Of course, a more simple pattern with less variety of colour would cost less.

Stairs. The steps are formed in York stone, rough, and covered with the cement to imitate Bath, Portland, or any other stone; or simply by itself, as executed by Mr. T. Cubitt with great success.

Walls generally are worked in the manner described in the directions for use in the circular. At the New Sun Fire Office, and generally, the panels are worked in the cement mixed with sand, and the mouldings run in the pure cement. It is, of course, easy to imitate any stone or colour. At the Swindon station of the Great Western Railway, it is intended to finish the walls of the engine house of a light buff colour, rubbed down and stopped, and finish it with slight polish; the cost of this would be about 4*s.* 6*d.* per yard super.

Architraves, surbases, skirting, and every description of moulding can be worked in it. It presents a finer face and cleaner aris than wood; requires less paint; neither shrinks nor cracks; is not so liable to injury; and while in the most simple descriptions of work it is cheaper, in the more elaborate its economy renders it far superior to that material. Chimney-pieces, columns, pilasters, and every description of work can be executed in this cement with polish and splendour of appearance equal to scagliola in imitation of any marble; and while the cost of scagliola varies from 5*s.* to 8*s.* 6*d.* per foot, super., this cement does not exceed 4*s.* 6*d.* It is equally as easy to remove as marble, and is as readily repaired when injured. Great beauty might be derived from a judicious employment of mosaic with the imitation marble. The Grecian fret in white or blue (Prussian), let in imitation sienna or *giallo antico* in the jambs of chimney pieces, the archivolts of doors, friezes, panels, &c., can easily be conceived. The cost of such work, if the pattern were not very elaborate, involving a great variety of colours, would not be so great as if executed in finished scagliola without mosaic—merely the simple marble. In cases where polychrome decoration is sought, as in some Gothic cathedrals and the varieties of the Lombard style, the advantages of this cement is apparent; being as hard as marble, and the colours equally as durable. Gothic pillars can be worked round a core of brick work, and an endless variety of ornament which is characteristic of the style either cast or moulded in this cement may be executed at a cost trifling in comparison with either wood or stone.

REMARKS ON THE LETTER BY "AN ADMIRER OF ARCHITECTURE."

SIR—Notwithstanding that you yourself have already replied to "An Admirer of Architecture," in the pertinent and forcible editorial note attached to his letter, I could wish, as the writer of one of the articles he has commented upon, to be allowed to say something further, since he appears to have greatly misconceived one or two points. Misconceive he certainly does, when he supposes that the remarks on the "Threadneedle Street structure" were penned chiefly for the purpose of crying up that building, and decrying almost every other production of architecture in the metropolis at all similar in style, or sufficiently so to admit of any comparison. I certainly did bring forward many instances of buildings—some of them tolerably recent ones—and however unfair or illiberal my estimate of them may be, "Admirer" seems to acquiesce in it, for he has not attempted to gainsay it, by pointing out merits in them, or any one of them, to which I had wilfully shut my eyes. That he objects to my having expressly named several buildings which I hold to be exceedingly tasteless and mediocre, I can hardly for a moment suppose; or if he does so he is most strangely inconsistent, because he himself says it is fairer to allude to particular parties, or to their respective works, than to deal in vague and sweeping denouncements which criminate all alike, without distinction. If, therefore, I erred at all, it was not in naming any, but in not naming every one of the buildings to which I could easily have adverted, as striking examples of false taste and the "pseudo-classical" system.

I am wrong, however, in saying that I could have done so "easily" for it would have been a tedious task to point out, one by one, all the instances of the kind that might be enumerated. Still, from those which I did specify, it will not be very difficult to guess what others I should include among them; nor is there much danger of any one's fancying that I should *ex*clude from my list the British Fire Office in the Strand, or the church in Wyndham Place, both of them the productions of men who rank high in their profession—men who, it is to be presumed, are not of "*uncultured* minds," for they have travelled, and, it may be presumed, have studied also, and applied themselves to their art with more than ordinary diligence. Advantages they certainly have had that do not fall to the lot of every one in the profession, for they have had opportunities both ample and frequent put in their way,—one of them especially; yet how far they have turned them to account, or what particular talent or taste they have manifested, may be judged from the above-mentioned specimens of it: not from them alone, but their works generally.

Under-rate their buildings, and many others which enjoy no small degree of credit with the public, I most certainly do, because I rate them at a very much lower value than they have hitherto passed at, and of course, as I myself conceive, at a much juster one, and more corresponding to their actual worth as productions of architecture. Sooner or later, things which have been greatly *over-rated* sink to their proper level; although the first attempt to correct public opinion in regard to them may appear invidious, if not malevolent, especially in those cases where an imposing reputation has been acquired, that carries with it a degree of authority which persons in general are unable to dispute, and which those who are able do not care to oppose. In matters of literature and art, and not least of all in architecture, the influence of names is exceedingly great, to a degree that is not only magical, but positively injurious, for it causes that which requires to be assayed to be set up as a standard of excellence—an authority to which all ought to bow down. A reputation may stand very high upon the whole, and not undeservedly so, and yet be no pledge whatever for excellence in many productions that may be sheltered by it, as being productions of the same mind. Such I conceive to be the case with regard to Sir Christopher Wren: as the author of St. Paul's, he is fully entitled to all the honour that has been heaped upon his name, but all his other works are so immeasurably inferior—some of them, indeed, so utterly unworthy of being considered productions of intellect or art—that it is with difficulty we can persuade ourselves that they were conceptions of the same mind. The fact, indeed, of their being by him admits not of doubt or dispute; but internal evidence afforded by the things themselves is wanting altogether. Nevertheless, because such is the fact, and for no other reason, our admiration is claimed for everything that passes under his name, without reference to intrinsic merit, or without the least suspicion that what is by the author of one of the noblest monuments of English architecture can be other than truly excellent in itself. Thus is a name converted into a positive standard of merit; criticism is merged in mere prejudice or else hypocrisy; admiration is affected where it is not felt; the expression of opinion is reprobated as flying in the face of unquestionable authority; and uninquiring deference to and superstitious veneration of great names are inculcated, which operate in reality injuriously to the real interests of art, and impede its advancement. We bow down to names, and make them our idols. It is expected that those of Vitruvius, Michael Angelo, and Palladio, should be worshipped by us: to doubt, to call in question, or even to inquire into the real merits of those who have been so pinnacled aloft, is regarded as a species of actual profaneness;—which may, after all, be very right and prudent, for some reputations of the kind are by no means of a description that will bear being handled and closely inspected; and most unpleasant must it be to their admirers to have unsightly flaws and defects pointed out in their idols, and to hear objections started which they know not how to refute or ward off.

But I am now wandering very wide astray, and must therefore skip back at once to "Admirer" and his remarks. Among them is one from which it might be inferred that I had deprecated, or attempted to dissuade from, the study of Stuart's "Athens," and other works of that class. Now what I complain of is precisely the reverse; that they are learnt by rote, and copied without being *studied* scarcely at all; for were they studied, their spirit would be caught, and infused into modern works, which would nevertheless be marked by original feeling, some novelty of treatment, and some freshness of ideas. Instead of this being done, the works alluded to are made use of as little more than mere books of patterns; and wherever they are deviated from at all, it is more frequently than not entirely for the worse, it being done not with any attempt to advance a step farther than the originals, but rather to retrograde a step or two back. Thus while we have Grecian-Doric porticos professedly after that of the Parthenon, or the Theseion, the resemblance extends to no more than the columns themselves; for although they may be copied with facsimile accuracy, as if fidelity in that respect was in itself all-sufficient, so very greatly are the original buildings departed from in almost every other circumstance, that almost all in them that amounts to design, or contributes to effect, is entirely obliterated. Inner columns and depth of pronaos behind them are omitted, and metopes and pediments are left blank, as if those were altogether matters of perfect indifference and no moment, although to vary ever so little from exactness in the minutest details in the columns and mouldings of the entablature would be deemed a great license. Now were Grecian architecture really studied in a liberal and artist-like spirit, such would not be the case. Its orders and other features would be looked to as standard *types* of the style, as models upon which our taste in that style is to be formed; not—as is now the case—as *stereotype* copies which admit of no modification nor any diversity of expression, be they applied ever so differently from what they are in the structures from which they are derived. Of course the junior student must begin by copying from Stuart, in order to familiarize himself with those models perfectly, and as preparatory to farther study of their character. But the misfortune is that very few indeed ever think of getting beyond that first step; with copying they begin, and with copying they end. But the ancient orders, we are told, will not bear being trifled or tampered with. Yet, surely, to make use of them with artist-like intelligence and freedom, and to treat them with congenial taste, is quite a different thing from tampering with them; and that it is more than every one is able to do, may be taken for granted, because it is not every architect who is an artist; but to maintain that it is more than *any one* is able to do, would almost be equivalent to saying that no architect is an artist, or can be trusted for a moment if he attempts to innovate in matters where others are content implicitly to follow those who have preceded them. So much for the difference between studying Stuart, and merely tearing a leaf out of his book, as may serve immediate occasion.

But, it is said, "Mr. Barry has *his* book of reference, too"; no doubt, otherwise he would hardly have made himself so familiar with the genius and capabilities of the style in which he has shown mastery; but then he has evidently turned it to a very different account than those do their "Stuart," who do little more than merely take from it the exterior or façade of a portico, to stick up where it shows itself to be merely borrowed, and perhaps most tastelessly misapplied. Many details and some entire features in some of Mr. Barry's most successful Italian, designs may certainly be traced to previous examples that have been delineated; yet that hardly amounts to copying, for they are frequently so very greatly improved upon, and recombined with so much taste as to acquire a heightened charm. Of many the merit hardly shows itself in the original compositions, where there is generally together with much to please, almost always something to offend more or less, whereas our English architect's productions are stamped by a refined elegance diffused over the whole, and kept [illegible] throughout. But if, as would seem intended to be insinuated, an[illegible] else might, by pursuing the same method, accomplish with the[illegible] facility quite as much as Mr. Barry, why then, in the name of common sense, do they not do so at once, and deliver us from such specimens of Italian, as the City Club-house? And why do they not adopt the same with regard to Grecian architecture, and deliver us from the mawkish and spiritless schoolboy copies of it that are now served up to us *ad nauseam?* The reason why what is apparently so easy is not done, is perhaps that the taste requisite for accomplishing it is wanting. And I fully agree with "Admirer," when he ascribes so much to that natural taste which can neither be learnt nor unlearnt; cordially, also, do I assent to his opinion, that quite as much depends upon the spirit and taste with which a style is treated, as upon the style itself.—But it is time to conclude this long letter, and I will, therefore, merely add that I wish "Admirer" had distinctly specified the particular parties or their works, to whom he alludes with so much approbation as "examples of design in distant parts of England." And as this letter will, no doubt, meet his eye, I hope it will induce him to do so now, for most happy shall I be to learn that there are productions of very great merit, which are as yet hardly known even by reputation in this part of the kingdom.

I remain, &c.,
THE AUTHOR OF THE ARTICLE ON THE
THREADNEEDLE STREET STRUCTURE.

REVIEWS.

Architectural Illustrations of Windsor Castle. By MICHAEL GANDY and BENJAMIN BAUD, Architects. *With a Concise Historical and Architectural Account, by* JOHN BRITTON, F.S.A., *author of* "*Architectural and Cathedral Antiquities,*" "*Dictionary of Architecture,*" *&c.* Folio, 40 plates. London, 1842.

Now that it is completed, or rather brought to a conclusion—a very great deal that would have been the most interesting of all as graphic illustration, and perfectly new to the public, being left altogether untouched—and now that we have the letter-press before us, we can speak of this second work on Windsor Castle more decidedly than when our notice was confined to some of the plates during its progress. Whatever be its deficiencies in other respects in regard to illustrations, it gives us one which was neither promised, nor is even now mentioned in the list of engravings, one for which we were so totally unprepared that it made us stare; and no doubt our readers will stare too when told that it is no other than an illustration of—"Benjamin Baud, architect"—and as it would seem, *the* architect of Windsor Castle, a large view of the building being introduced at his elbow. This is certainly original—perhaps *un peu fort*, and what most people may consider a piece of puppyism; at any rate it is calculated to call forth comments and remarks, not very likely to be altogether agreeable to the gentleman who has hit upon a notable method of advertising himself. If there was to be the portrait of any one at all, it should most assuredly have been that of SIR JEFFRY WYATVILLE—of the individual who remodelled the Castle, and gave it its present form and character—of the architectural composer and performer, not of his "bellows-blower"! Or is there something more in the matter than meets the eye?—is it pregnant with a meaning that might not be expressed otherwise than thus hieroglyphically? Can it be intended as a delicate insinuation to the effect that the designs for the alteration of the Castle, hitherto attributed solely to Sir Jeffry, emanated from Mr. Baud, and that it was he who furnished his employer with ideas for his grand work? It is possible, because such things have happened ere now; for, as his friend Mr. Britton can tell him, works have been given to the public under the names of parties who were only their ostensible authors, the real authors being kept out of sight, behind the scenes along with other lumber. In the literary world, it is no very uncommon practice for those who have a name worth borrowing, to lend it—or rather to *sell* it to publications they never wrote—probably never read. There are tricks in all trades; why not then in architecture as well as in authorship? why may not "the truly estimable Sir Jeffry Wyatville," as Mr. Britton here calls him, have, if not sold his name to, have *purchased* of Mr. Baud, services very far more important than those usually expected from an architect's assistant? Strange and ugly suspicions come across us; and so far from being removed, they are rather confirmed by another circumstance in this very remarkable portrait, which, though not exactly an architectural *illustration*, may be intended to throw some *light* upon a matter in regard to which the public has hitherto been kept entirely in the dark. What we allude to is the plan of the "West of London and Westminster Cemetery," which is also introduced as one of the accessories or "by-play" touches in the portrait. Now that is avowedly the production of Mr. Baud—one which few in the profession will envy him the credit of, however they may envy him the job—therefore the juxtaposition of the two subjects, the Cemetery and the Castle, expresses as clearly as can be done in painting, that both are productions of the same genius.

If such be not the meaning, what meaning at all can there be? Is it merely a piece of waggish mystification on the part of Benjamin and his painter? or shall we say that the thrusting in his portrait at all into the work has no other signification than as a sign of Benjamin's conceit? Be that as it may, *we* have no particular cause to object to its appearance, since it has served in lieu of other proem; and although it has detained us rather long, it is quite as pertinent, quite as much to the point, as introductions to articles of criticism generally are; not very much more rigmarole, not altogether so hackneyed, and probably a degree or two less dull. Possibly, too, what we have said may lead some one to take up his pen, and favour us with a volume, or at least an essay, of "Historic Doubts" as to whether Windsor Castle was the work of Jeffry Wyatville or Benjamin Baud.

We now turn at once to the architectural illustrations themselves, which are certainly very satisfactory as far as they go, and of a more popular character than those in Mr. Ashton's work, because a great many of them are pictorial and perspective views, consequently possess greater interest for persons in general than geometrical drawings, to which the other work is confined, and which, to those who perfectly understand them and properly value them, are in themselves most indispensable and important of all, but do not always convey sufficient idea of the effect of a building so represented; more especially when, like Windsor Castle, it happens to be a complex and extensive pile, composed of parts and masses receding from or advancing before each other, in a manner intelligible enough from the ground plan, but nevertheless requiring to be distinctly expressed to the eye, perspectively. While the want of delineations of the last-mentioned kind as accompaniments to the strictly architectural drawings has rendered many publications wholly unattractive except for those who make use of them as studies; many graphic works—of first-rate merit as such—are by no means so valuable as they would be, were some geometrical explanations of the subjects they contain, introduced into them. In this respect these illustrations of Windsor Castle are got up in a judicious manner, for not only is there a series of elevations showing the whole of the exterior, but also several plates of details and parts at large. But then, there is one most unaccountable omission, which detracts very materially indeed from the serviceableness of the work, there being not a single ground plan, not even of the principal floor, consequently the book is strangely incomplete, since no information whatever is now to be obtained from it relative to the internal arrangement of the building, the accommodations provided in it, the disposition, form, or size of the various apartments, their respective names and purposes, and the manner in which they are either connected and made to communicate with, or cut off from each other—particulars highly important to be understood, and which, in this case, would hardly be passed over with indifference even by those who would bestow scarcely any attention upon plans in general.

If the omission was entirely owing to oversight, it was very strange; if on the contrary, an intentional one stranger still, and utterly inexplicable; nor is such omission rendered at all less glaring by the thrusting into the work such a very superfluous "illustration" as is the portrait—of one, too, who is not the most illustrious in his profession. Gladly would we, and most others also, we suspect, give that, and not that alone, but one or two of the other subjects in exchange for a plan of the castle, more especially as there are one or two subjects of comparatively very little value. There, is, it is true, what is well enough in its way, and very acceptable in itself, namely an outline block, or situation's plan of the castle and the buildings immediately connected with it, yet that shows only the external arrangement, and what might be tolerably well comprehended from the views. If therefore we wish to ascertain how the interior of the castle is laid out, and what alterations and improvements Sir Jeffry introduced into it, so as to render it more habitable than it was before, we must have recourse to Mr. Ashton's work, which gives not only detailed plans of the whole of it in its present state, but others showing what it was previously to the late alterations and additions. It is evident from them that the architect had neither few nor small difficulties to contend with, and it was, perhaps, rather fortunate than otherwise, upon the whole that such was the case, since had it not been for them, he would probably have missed some of the very best points in the plan, to which he was driven in order to get over those obstacles. There certainly are not only some novel, but some striking and happily-contrived parts within the Castle; nor is it in the least degree unreasonable, therefore, if we make it a complaint against both the publications which are devoted to the subject, and against the present one more particularly, that they have done nothing to gratify our curiosity relative to its internal architecture. To say that such "illustration" formed no part of their plan, is anything but a satisfactory excuse for the omission, the very thing complained of, being, that what was very essential to its completeness has been purposely excluded from it, and that no care has been taken to guard against disappointment by making their titles announce that both works confined architectural illustration to the mere exterior of the edifice. Not very much more satisfactory is to be told, as we are by one of them, that if further illustration has not been attempted, it is because Sir Jeffry himself considered the interior to be comparatively—a failure, shall we call it, or merely say, comparatively unworthy of attention? and acknowledged, virtually at least, if not expressly, that instead of being left to his own judgment, he had been controlled by, and compelled to give way to, the false taste and the caprices of his royal patron, so far, therefore, in a manner disowning it as his own work, or a work at all worthy of him. It is alleged, in excuse for not showing the interior, that many parts of it, and much of its present decoration, are likely to be altered and fitted up afresh, some time or other. No doubt, for what structure of the kind escapes retouches from time to time; but it is not at all likely that alterations to any extent will take place within the castle for a very long while to come; nor whenever made, would such alterations in any way diminish the interest and value of illustrations which in such case would become faithful records of what the interior of Windsor Castle is in its present state. Whatever, too, may be the case with respect to the strictly private apartments, or to those intended for the accommodation of visitors, there must, at any rate, be some if not several which are more or less worth being architecturally explained, or graphically described, on account of their importance, their character, and their effect. Or are we to conclude after all, that as far as architecture is concerned, there is absolutely nothing within the castle that merits attention, nothing in any degree worth studying, nothing to repay curiosity? Are we now to suppose that the "Grand corridor" itself, which has been spoken of as something quite extraordinary and superlative, is in reality "no better than it should be"—of but very *so-soish* character—perhaps somewhat too Strawberry-Hill gothic in style? And then the Waterloo chamber, St. George's hall, the state entrance and staircase, —are not they worth showing either in views, or by particular sections of them? It is true these last-mentioned parts of the interior can be seen by the public; but if that be any good reason for no illustrations of either kind, being given of them, the same reason might be made use of as an argument to prove that there was no occasion for either of the publications, which are now entirely devoted to the exterior of the castle, since the latter is, by far, more open to public inspection, and that freely, which is certainly not the case as regards any part of the interior, where no time is allowed for examining, much less for studying or deliberately taking note of what we are permitted merely to view, and of which, therefore, only the general effect can be judged. In order properly to understand the anatomy, if we may so term it, of Windsor Castle, full as many plans and sections (both general ones, and particular ones on a larger scale,) besides views, would be required, as there now are engravings of the exterior both in the work before us, and its predecessor. Though this is no exaggeration, as any one who understands the subject may convince himself, by examining the plan in Mr. Ashton's work, it would, we admit, be unreasonable to look for illustration to anything like that extent, except, perhaps, in a work published by government—and for that being ever done in this country, we might as well look for a miracle, or look for Windsor Castle's being swallowed up by an earthquake.

Because it could not be done after that extravagant fashion—as, no doubt, what we have above hinted at will be considered—is no reason, however, why nothing of the kind should have been attempted. Thankful should we have been for something, had it amounted to no more than three or four judiciously chosen sections, through some of the principal and most interesting parts of the interior; for the sake of which we would willingly give up double that number of the present illustrations, since some of the latter are hardly required at all, there being little in them besides what is shown in other portions of the general elevation to which they belong. With the exception of a single section, and that not through the upper floors of the building, no part of the interior was shown in that one of the two works which was first completed, it was therefore to be expected that Messrs. G. & B. would have taken advantage of that circumstance by introducing into their own publication what would have formed a new and highly interesting feature in it. Instead, however, of doing more in that respect, they have, as we have already observed, done less, for their work contains not even a plan, so that the interior of the castle is left totally unexplained by it. However well, therefore, they may have manœuvred in other respects, they have certainly shown no very great tact in thus flinging away the very best trump-card of all that was in their hand. The only person who has turned the rival publication to his own advantage is their editor, and after what fashion he has done so, we shall presently say.

Admitting that it would have been too expensive to employ the pencil for describing the interior of the castle or any part of it, what was not attempted to be done by the pencil, might have been accomplished by the *pen*—at least, as far as accurate and intelligent description can supply the place of drawings, without the aid of which last, the best written description cannot be thoroughly satisfactory as explanation, however interesting it may be in itself, and however instructive it may have been rendered, by the criticism mingled with it. For such description, however, a very different pen is required from that wielded.

Mr. Britton, in the preface, boasts of his long acquaintance with Windsor Castle, and of having repeatedly written and pronounced various historical, descriptive, and critical remarks on it. If so, he must quite have exhausted his powers of description and criticism before he wrote the present account of it, for it contains nothing that amounts to either the one or the other.

Ancient and Modern Architecture. Edited by M. Jules Gailhabaud. London, Dido

We have received from the enterprising firm of Didot and Co. of London and Paris, the first, or specimen number of a serial work intended to illustrate the several styles of architecture and their application to various classes of buildings. Commencing with the Celtic and Pelasgic, the rude heaps of barbarous ages, the architecture of the east and the west, of the Pharaohs of the present day, is to be exhibited from authentic examples. Thus the present number contains three engravings of the Speos, dedicated to Athor at Ebsamboul in Nubia, and two of the Kailasa at Ellora, accompanied with descriptive letter-press from the pen of M. Jules Gailhabaud, an eminent archæological writer, and translated and extended by Mr. F. Arundale. It is evident that the field is wide, and the mode in which it is to be entered is sketched in the prospectus. Thus we find the temple of Edfou in Egypt, that of Theseus at Athens, the temple of Segesta, the Basilicas of Constantine, St. Clement at Rome, and Torcello near Venice, the Church of St. Vital at Ravenna, the Mosque of Ebn Touloun at Cairo, the Certosa of Pavia, and the Cathedrals of Bonn, Fribourg and Paris, from part of the intended course.

The first and most essential recommendation of the present plan is, that it is cheap, the number before us containing four plates costing no more than four shillings; then we may remark that the engravings are admirably executed, and that no expense has been spared in rendering them worthy of a work of such importance; the letter-press is also exceedingly good. The list of proposed contributors includes Messrs. Gomard, Champollion, Figeac, Langlois, Albert Lenoir, and Radil Rochette; while the English translation and illustration is undertaken by Mr. Arundale. All these advantages are sufficient to recommend it to the public patronage.

ON DRAINAGE.

Lecture by Mr. Smith of Deanston, delivered before the Members of the Royal Agricultural Society, at Bristol; Wednesday, July 13, 1842.

(From the Bristol Mercury.)

I need not, before such an audience. say that to the agriculturist the dryness of land is of great importance—that, in fact the dry condition of the soil is the foundation of all good husbandry. It is beneficial, in the first place, to the working of the soil; it is beneficial also, to the after-growth of the plants, and there is scarcely any labour connected with agriculture which is not facilitated by the dryness of the soil. If we look on the face of nature we may gather instruction on this subject; for if we find a tree stronger than its neighbour, we shall find that there the soil is deep and in a dry condition. If we see a stronger and darker coloured herbage growing on the hill side, there the soil will again be found deep, and in a dry condition. There is not one of the various soils on the surface of the United Kingdom which will not be much improved by being placed in a dry condition, if they are not so by nature. I would say that even on a subsoil of gravel or sand the introduction of the thorough-drain system would be highly beneficial; but as there is only a small portion of that sort of soil in this country, the greater part being super imposed upon a wet soil, it becomes of the very first importance to the progress of improvement in agriculture that means be taken to render the condition of the soil dry. Many attempts have been made with that view, but they have generally failed, in consequence of not having been done on a proper principle. The first system introduced into this country, was to excavate deep drains, for the purpose of catching the water that rose from below in the form of spring water. These were, to a certain extent, effectual, and no doubt removed a great deal of the difficulty which agriculturists had to contend with, on land partially wet and partially dry; but until the introduction of the thorough drain system, there was not he power of draining land, on whatever sub-soil, resting, and rendering it thoroughly and completely dry. The purpose of this lecture is to illustrate, first, the principle on which this system acts; then, to show the advantages which would arise to the agriculturist in carrying on the different processes with respect to the various crops; and then to explain the modes employed to render this drainage effective, both as to the cutting of them, and to the preservation of the openings made for the escape of the water.

[Mr. Smith here illustrated by a diagram, his method of thorough draining; the soil, the subsoil, the drains, &c. being represented.]

In referring to two lines, representing the directions of drains, he stated that he had drawn one at a greater inclination than the other, to show the advantage of making the drains deeper than they generally were. The prevailing practice was to make the drains two feet deep, but he preferred an additional six inches—for this reason—that it was of great importance to allow the water to go off as quickly as possible, and this advantage was secured by cutting the drain to a greater declination. People were apt to suppose that at a great depth water would not go off at all, but this was a mistake. Another advantage arising from a deep drain was that it allowed the whole bank of soil to become completely dry, and it consequently required a very heavy rain to wet it. The action of the atmosphere, too, required to be taken into account. He would not enter upon the chemical question, but it was well known that soils were much improved by the action of the air, and this advantage could only be secured after the water was withdrawn.

To render the field completely dry, it was necessary that a great number of drains should be cut, and that they should be laid off in parallel lines beginning at the highest side of the field. This secures a thorough drying, and it has been found that when the lines run parallel, much greater effect is produced than when they are drawn across. When drawn across, the drains may catch the water, but experience has shown that it does not run off so readily.

With regard to the distance at which the drains should be placed, that will depend on the nature of the soil. If the field has been subsoiled, it is of less importance; because the plough will form artificial channels in the soil below. If it is a stiff soil, it will keep long upon the surface; and the more free the soil is, the greater tendency it has to allow the water to pass; so that you will find that, on a stiff soil, such as the stiffer clays, taking into account the nature of the subsoil and the soil itself, about the same drain will serve on all soils. The distances in use are generally from 15 to 20 feet; in some soils individuals have been induced to put in the drains at 12 feet; but I conceive that that is, in some degree, throwing away money. From observations which I have made myself on all sorts of soil, in different parts of the country, I am inclined to recommend about 16 to 20 feet as the distance from one drain to the other.

The way in which I usually proceed in draining, is, first to find a good bottom-level to run the drain into. And here I may remark, that in some parts of the country there is sometimes difficulty in getting an open level to carry off the whole water of the district; but I think that by a proper application of the principles of engineering, it may be accomplished in most situations; because it is found that if proper channels are executed, a larger quantity of water will be discharged with a very small fall. In an instance in which I was engaged in the endeavour to carry off water, I found that in a drop of four inches in a mile, thirty feet wide and six feet deep, I could discharge 300 tons of water per minute; which is much more than would fall in a very extensive district indeed. So that I have no doubt, if means be taken to carry off the main level, that a fall may be had.

With regard to the fall of the great main, the receiving drain, I should make that drain if possible about four feet deep—three feet six inches will do; but in order to have a drop from the one drain into the other, I usually make the main drain four feet deep, the receiving drain three feet deep, and the parallel drains two feet six inches. When there is any rise in the ground, or any hollows over which the water can very well flow, it is necessary to make a cad's drain That should be made about six inches deeper than the other drains which fall into it; then running on, it discharges itself into the main drain.

With regard to the manner of executing the drains, there are various modes recommended, and I have found, on looking to land which has been drained a great many years, that when the draining has been performed carefully, all the different modes employed for the purpose of keeping the drains open have been quite effective. Indeed, a great deal of the want of effect in the duration of drains has been owing to the bad execution. In some instances faggots have been introduced for the purpose of preserving the openings of the drain, and these have been found to continue and to preserve the openings in a perfect state for nine years—in some instances I have ascertained for twenty years.

In Scotland the peat-top is frequently used to form the tiles for drains. It does pretty well in clays which are pretty stiff, but does not do so well in softer soils; in the same way, in some of the sandy soils, the sides not being sufficient to resist the pressure of the top, the tile gradually sinks down and closes up the drain.

Another mode of filling drains is by stones broken into the usual size for making roads; and, although much has been said against the use of this sort of filling, I have found from experience that when properly executed the work is as durable as can be required. In most instances where stones can be had, and where tiles are expensive, I should very much prefer them to the tiles; and there is this advantage connected with it, that it prevents any virmin from travelling in the openings of the drain, such as rats and mice, which do a great deal of mischief. The great point is, to be very careful in covering over at the top. As soon as wet comes, the sand and other materials silt down into the stones, and they are completely choked up. I have found that drains not carefully executed, were completely destroyed in the course of a couple of years. On the contrary, if drains are so packed that the water falls down on both sides, (the parts over-lapping each other) there is no opening whatever for the sand to find its way down. If drains are carefully cleared in this manner, I will warrant their duration for almost any period of time. I have executed myself about 130 miles of drains in this way, and have had them all filled with stones; many of them have been done 15 years, and there has not been a single instance of failure.

Many persons who have visited my farm have asked whether or not the drains would be choked up in particular positions. I have always asked them what positions they referred to, and have opened it that they may see; and in no instance have I found a single drain choked up. I have the drains of 100 acres all discharged into one pond, provided for the purpose of seeing how much deposit came from the drain; and although we have had heavy rain, I have never seen the water in the pond tinged as if there was much soil in it. I can, therefore, safely recommend stones as a very sufficient drainage; and in many parts of the country it is much cheaper than tiles.

The next filling which has been used for preserving the openings of drains is the drain tile. These are usually made of clay, and burnt. They are found to be very handy and very useful; and where stones are not to be had they are to be preferred. But there are districts where the clay tile cannot be procured at any reasonable price; they are usually 30*s*. a thousand, but in some districts they are not to be had at all. Lord James Hay has recently discovered a method of making them of concrete stones cemented by lime; and so far as I have made any calculation of the expence, I think that in most instances they will come considerably cheaper than the brick tile, and, if executed on the ground, where they will not have to be carried far, the breakage will be found to be very little, and they will be found to be exceedingly durable. We know that the cement made of lime is more lasting when covered up than if exposed to the atmosphere; instances of this may be found in the lime frequently discovered in old buildings, which has been found to be perfect after hundreds of years.

There are two other modes of making drains—peat earth has been cut into a shape somewhat like a hollow wedge; and a sort of instrument has been made for the purpose of cutting peat earth into the form of the tile, so as to produce an opening not liable to the objection of the wedge, which frequently sinks and fills up the opening. A stone is frequently used to lay the concrete tile upon, and prevent its sinking. It is also made of concrete.

Much has been said with regard to the application of this system to different soils; and many persons have expressed the opinion that, in some of the very stiff clays, drains of this sort would not be efficacious, and that the application of the subsoil plough after the draining would have no good effect. With the view of showing the beneficial results, both of draining and subsoiling, I have brought some specimens of different clays, in order to show what improvement can be made. Here is a piece from the Pass of Stirling. This kind of soil has been cultivated from a subsoil, and has been known to produce excellent crops of Swedish turnips. Here is another very hard clay from Yorkshire.

A gentleman inquired how long after the subsoiling the land assumed a different character.

Mr. Smith—Almost immediately—in the very first year. It requires some years before it becomes adapted for a turnip soil. I have a specimen of some soil which twenty years ago was so extremely stiff from the alluvial deposit in the Pass of Stirling, that it required to be broken with large mallets, to reduce, mechanically, the great lumps of soil. Thorough draining or subsoiling was never thought of till about twenty years ago, when this land was first drained; and now they get from it very splendid crops of turnips, and in almost any season. Here is a piece of the improved subsoil before having been drained by the subsoiling, the same as the other. While we are on this point, I will produce the two specimens of subsoil from my own farm.

A gentleman wished to be informed of the nature of the soil in Mr. Smith's farm.

Mr. Smith—It varies. In some parts it is sandy clay, and in others, clay perfectly impervious to water. When I first began to subsoil there was not more than three or four inches of active soil, properly so called, for growing plants; after a labour of about fifteen years I have now an active soil of sixteen inches, and can turn over that in any part of the farm.

A Gentleman.—How near are the drains in order to produce that result?

Mr. Smith—Twenty feet. Having thus described the various modes in which the drains have been formed, and having stated that, so far as my experience and observation go, I think a distance of about eighteen or twenty feet from drain to drain is a proper distance for almost any subsoil, I shall now proceed to detail the application of the subsoil plough.

When I first began to cultivate my own farm, although I had put in the drains, I found they were not so efficacious as I at first expected, and I then began to think of stirring up the subsoil, which gave rise to the idea of a subsoil plough. I thought I must construct an instrument which would execute the work with the least possible power. I made my plough very strong, and of that form to which the least resistance would be opposed, at the same time taking care to have sufficient power fairly to stir up the soil.

I will here explain the principle of the subsoil plough, because I have found that many persons, although seemingly acquainted with it, have not the proper notion of the principle on which it is based. The great principle is, that there are many subsoils, which, though capable of being converted into a good soil, yet if brought up and mixed with the active soil, will so far deteriorate it as to make it for some time sterile. It therefore occurred to me that the great point would be to stir up the subsoil, still retaining the good soil on the surface. Stirring up the subsoil would, in the first place, very much facilitate the escape of the water into the drains; and secondly, in consequence of the passage of the water through the stirred up subsoil, and the attendant admission of air, it would be so acted upon as to be converted into good soil, while at the same time I was having all the advantages of working the active soil as before.

Upon the application of this principle, I found that which I had supposed before was right, and I have been successful in every instance in which I have tried it. The process of applying the subsoil plough is this; a common plough goes along first, and removes a furrow of the active soil. After tha the subsoil plough passes along below, and scarifies the soil to the depth of from twelve to sixteen inches, in some instances eighteen inches. This is continued furrow after furrow, the plough going first to lay the active soil on the part already opened up; then the plough comes a second time and takes off a furrow from another part of the soil, and places it on that part which is already scarified.

Much has been said with regard to the proper period for applying the subsoil plough, some conceiving that it should be applied immediately, and others, at some period after the drains have been out. I think that in places where the drains have much effect, the subsoil plough may be applied the following year; but in clay soils it is of great importance to give the clay sufficient time to dry, and to have it in a sort of friable state; because, in the application of the subsoil plough, when clay subsoil has been recently drained, and it is not sufficiently dry, more harm is done than good; the clay being worked in a wet state is almost prepared for making bricks; and if we once work it in that state it is a long period before it recovers its friable property again. Therefore, I should say that in soils rather free, the subsoil plough may be used the second year after the drainage.

The proper time to execute drains is in the summer season, because you can then get it much more tidily done, and the drains are prevented from running; because in many places there are little sandy veins and portions of running sand, which are very apt to fall in before the drains are covered up. In the winter season this is almost sure to be so; and another disadvantage is, that you may be taken with frost, which draws off the adhesion of the earth, so that it falls down, and fills up the drain. It is best also to execute them in grass land before it is broken up for cropping, because otherwise it is much too soft. Executing it therefore in the summer season on the lee produces very little loss indeed, because you find that the growth of the grass in the after part of the season will be so much increased by the execution of the drains, that you will be repaid for the time lost for the use of the pasture during the time the drains were in process of execution. After the drains have been completed, I would recommend you to take a crop from the land, and if the land has been pretty good, it will, perhaps, afford two crops; at all events, one crop should be taken; and that will pass over one summer before the subsoil is to be ploughed. During this season the earth between the two surfaces has time to dry; it is much more friable, and the subsoil plough will be much more efficacious in stirring it up. Besides, it often happens that there are stones in the soil, which of course, must be removed before you can proceed with good husbandry; and it will be found that, in consequence of the contraction of the soil, they have become in some degree loose, and will be turned out very easily by the subsoil plough. In many instances we have stones exceeding 200lb. weight, which are turned out very easily by the subsoil plough with four horses.

With regard to the direction in which the subsoiling ought to be carried, I should say decidedly at right angles with the drains, because you thereby form channels, from the centre to the side, in all directions. In that manne you form artificial channels from the very centre of the ridge into the drain and, although these may partially close up, still there is an openness given to the subsoil, which will permit the water to pass freely.

Having thus applied the subsoil plough to stir up the subsoil, the after cultivation may be the common rotation of the country, such as the farmer thinks suitable to the soil. But one thing which I would very much recommend is, that when agriculturists have subsoiled their land, they should follow the practice of laying down the land flat on the surface, without any ridges or furrows. There is nothing more injurious to the land than ridging it up. In the old modes of draining, it was quite necessary to have ridges and furrows; but now, when land is thoroughly drained, there is no occasion for it, and indeed it is hurtful; because when water falls on a rounded off surface, it immediately begins to sink away to the lower level, and the water which has fallen on the tops and middle parts of the ridges is added to the water on the side, which thus has to bear a great deal more than its own proportion of the water; the water carries portions of the soil along with it, and the cracks are constantly filling up by the running of the sand from the higher part of the ridge to the lower part. It must be obvious to everyone that when a field is laid down with ridges and furrows, especially on stiff land, a great part of the very best of the land runs down into those furrows, and is deposited in large quantities at the bottom of the ridge, thereby doing a great quantity of material mischief. If it is laid in a flat form, you get rid of this great evil, and obtain this advantage—that if the water is beneficial to the soil, which it certainly is, you have that benefit equally distributed; every part receives its own water, and receives the benefit which the water can give.

It is the suggestion of scientific gentlemen who have turned their attention to the subject of agricultural chemistry, that the rain in falling from the atmosphere absorbs a considerable quantity of ammonia; and if there is any affinity in the soil for ammonia, if the soil wants ammonia, the affinity will extract the ammonia from the water, the ammonia remaining in the soil for the nourishment of plants. It is also known, that where artificial manure is put into the soil, some of the fibrous parts of it will be carried away with the water, and be carried down to the region to which it belongs; and although not so near the surface as it was before, it is near enough for the plants to reach it when they put down their roots.

A very peculiar change takes place in any subsoil—it does not matter what composed of—after it is ploughed. This change begins to take place immediately, and the soil gradually goes from the state in which it was before to that of a mould. If you examine as oil which has become mould, it is of a very peculiar structure. It appears as if all the particles were connected together, and it seems to have some sort of attractive property by gathering together in that way. Vacuities for the air are thus formed, and there is a great tendency to absorb and retain as much moisture as is useful to the plant. If it is filled entirely with moisture it is injurious to the plant, but if there is a certain quantity, it becomes beneficial; and when a great depth of soil is attained, there is great advantage indeed, in anticipation of either a wet season or a dry one. In a wet season the water flows away, leaving the soil in a dry state; but in consequence of the mouldering state in which the soil is, it is very retentive of moisture, and there is a great magazine of water preserved in soil for a dry season. Being covered by the active soil, the drought may penetrate a few inches, but in consequence of the lower part of the soil being covered with this upper stratum, it is defended from the extreme action of the rain and a very dry atmosphere; consequently it will be found that in soil so treated and converted into this mouldy condition, in very dry seasons a sufficient quantity of moisture will be retained for the use of the plants, which will grow vigorously when land in the same neighbourhood is completely dry.

A notion has prevailed with some people, that it is possible to drain land too much. I do not think so, from the fact that the mould becomes an excellent magazine for the retention of moisture. A circumstance took place in regard to this in my own district, in 1826, a very dry season. In that year there was such a long period of dry weather that the pond was dried up, and there was a great deficiency of crops. I had a field which had been treated in the way I have explained, and I had a crop of hay on it. The hay in the country round was very poor indeed, producing not above half a crop. On this field, which I had deepened to 16 inches, I had a very splendid crop. A proprietor of land in the neighbourhood, one of the old school, resisted to the utmost of his conviction with regard to the result of thorough draining and subsoil ploughing. A person occasionally employed by me was also engaged in doing work for him. He had asked about thi hay, and the old gentleman was rather puzzled at the state of the crop, and exclaimed that he really thought I had drained the land so much that I should have no crop at all. He was immediately after this completely wedded to the system, and from that day has been vigorously engaged in introducing thorough draining and subsoiling all over his estate; and he is now having a great deal of poor soil, on a very rich and productive estate, treated in the same way. Taking the average of that gentleman's estate, I should say that he now produces double the quentity of corn that he used to obtain. He now grows potatoes where he could not grow them before, and on the old clay he produces regular and large crops of turnips.

A Gentleman inquired whether there was any land where subsoil-ploughing would be successful without thorough draining.

Mr. Smith—I am much obliged for that hint. Many persons have thought that ploughing the subsoil might do without draining, but there are few instances indeed in which that application of the plough will not be hurtful instead of being beneficial. If you have a retentive bottom which will not allow the moisture to pass away, it must remain till absorbed by the atmosphere; therefore the greater the chambers for receiving rain, so much the longer will the land be kept in a wet state. The practice which now prevails in the English clay districts of ploughing with a shallow harrow, has arisen from the experience of ages, which has taught them that on such soils you cannot cultivate wheat if you plough a deep furrow, because you make just so much the larger chambers to receive water. Even in open soils I would not recommend the application of the subsoil plough till the thorough draining has been executed.

A gentleman asked if it was necessary to repeat the subsoil ploughing.

Mr. Smith—It may not be essentially necessary to repeat it, but it is very beneficial. The practice I have adopted is to repeat the ploughing at every shift, every time I break up my fallow.

Another gentleman inquired if it was always done in the same line.

Mr. Smith—Generally; sometimes I have done it obliquely.

Did you ever try it diagonally?

Mr. Smith—Yes; and perhaps it is better to do it in that way according to the drop of the land. The first idea I had was to use the subsoil plough; then I thought I might use the trench plough, and that I might, the next shift, turn up the whole soil, so as to have a complete mixture. In some fields, where the soil was of better quality, and there was more vegetable matter, I had excellent crops; but, on the poorer soils, I found that by bringing up the subsoil to mix with the active soil, after the first shift, I did a great deal of mischief. I found, especially with regard to grass, that I could not get that growth of plants which I had before! and immediately on observing that, I resolved a third time to go over those fields, and that I would again use the subsoil plough: I have now fallen into the practice of doing so every time I turn. I took up at the first shift, perhaps about three inches, even in the poorest field; the next time three inches more; and by that means I gradually attained a thorough depth of soil to the extent of sixteen inches. On my own farm I have mentioned that I have a thorough depth of sixteen inches, but that is in consequence of using a trench plough on the second shift; and in some fields that was unsuccessful. If I had had then the experience I now have, I would from the beginning use the subsoil plough at each shift; and instead of going down the whole sixteen inches, I would only take up perhaps three inches the first time and three the next, till I had completed the depth of sixteen inches.

The lecturer was asked if he had ever used lumps of burnt clay.

Mr. Smith— I have seen it done, and it has been pretty successful, but there is considerable difficulty in the manufacture.

A Gentleman—As regards draining in the summer season, how do you get the level?

Mr. Smith—By the spirit-level, of course.

A Gentleman—The great object would be to get it done cheap; but it would be much more expensive if done in the summer.

Mr. Smith—No doubt; but if I had the choice of executing drains during the winter, at an expense of 50 per cent less than the summer, I would prefer doing it in summer. The efficiency is of far more importance than the expense.

A Gentleman objected, that in summer sometimes the land was too hard.

Mr. Smith—That may be the case in some places, but the great bulk of the land will retain as much moisture as will enable you to get through it with the plough. Of course that will be subject to variation in different parts of the country. In some places it had better be done when the ground is more moist. Still, I would recommend it to be done, not in the winter, but in the spring or autumn.

A Gentleman—I may perhaps be allowed to say that there are cases where subsoil ploughing is effective without thorough draining—as, for instance, in the soils of the moorlands. I have tried it myself in the moorlands, and have found that by simply breaking up that pan which holds up the water which made the lands dry in summer, and wet in winter, all the water escaped; and land before not worth 5s. an acre, let for 20s. after it was done. That was certainly a peculiar case.

A gentleman inquired whether the rocks under the stratification were horizontal or perpendicular.

Mr. Smith—There was very little stratification at all. I am perfectly aware of what has been stated with regard to destroying the pans, such as are placed upon gravel; and though in the gravel the opening must be at a considerable distance, and consequently the water will be long in finding its way out, if it gets into the channel it will go off easily. These dry soils retain moisture a great deal too long for agricultural purposes. A neighbour of mine was draining his land—a sort of irregular subsoil—and in some places had very considerable ruts or rising ground, with sandy or gravel bottom: he instructed his steward to stop the drain when he came to those holes. This was done, and two winters after the gentleman was coursing, one day, and all at once his horse sank over the fetlocks in the soft ground. He called out to his steward to show the cause, and his steward explained that this was the portion of land on which he had desired the drain to be stopped. I mention this fact to illustrate what I have said, that when agriculturists determine on draining a field, they should resolve to drain it wholly, otherwise they are only throwing the expense away. I have seen instances where persons have drained wet parts, and left what they considered dry undrained. They very soon found that the land which was formerly the wettest, was then driest, and that when the part which had been drained was ready to receive the seed, they were delayed a few days till the other portion was sufficiently dry. In a country such as ours, where we have much changeable weather, all agriculturists know the advantage of a single day. Now, if a field is uniformly drained all over, you will perhaps be able to sow your seed one, two, three, or four days earlier than if it were not drained; sometimes now you lose the opportunity altogether, because it frequently happens that two or three days intervene; very newly-dried will be ready for being sown, whereas other land which was not drained would require a week or fortnight before you could sow it.

With regard to the application of thorough draining on porous bottoms, no doubt much good will be effected without subsoil ploughing. I have found it most efficacious on sandy and gravel bottom. Many persons think that by so doing mischief would result; but I have known instances of land of that nature being very greatly improved after being stirred up by the application of the subsoil plough.

A Gentleman—Your observations apply to thorough draining; many people call it furrow draining. I wish to know whether you have any reference, to deep draining, and how, as in the case of a spring lying deep, you meet the difficulty occasioned by the water. Two feet and a half drains would not touch a spring such as that described on the diagram. How do you get away the spring water,

Mr. Smith—They are called furrow drains, because they are made in the furrows. I call it the mode of thorough draining. I use the term to express the result. They are called sometimes wedge drains, top drains, and tile drains; but the principle is, that you have the drains sufficiently close together to carry off the water quickly; and then, that the best mode of laying them off for that purpose is to arrange them in parallel lines, and carry them as much as possible in the sloping direction of the land.

With regard to springs, the spring water can do no harm till it enters the subsoil; so long as it keeps below that, you need not care about it. The moment it reaches the bottom of the drain, it finds its way into it, and will be carried off by it. I have found it necessary, sometimes, to carry a drain through the eye of the spring. Springs sometimes come in little channels, at other times in a sheet, according to the nature of the subsoil. When they come in a sheet, the cross cutting completely scarifies them. If a spring comes out at a round opening and happens to fall in between two drains, I have found it necessary to cut the drain into the eye of the spring. But in every instance where the water flows between two beds, I have found that, by cutting the drain across, it was completely cut off.

I will now describe to you the mode of constructing the draining tile of Lord James Hay. One way of doing it is to construct the tile on the ground, and then carefully place it in the drain. The other is to execute it in the drain as you go along, and immediately to cover it up. The composition of the tile may be varied considerably, but the proportions which I have found to do very well are—

Lime. . . .	1 part	Blackened cinders	½ part
Sharp fine sand . .	3 parts	Gravel	3 parts

making altogether 7½ parts, or 1 measure of lime to 6½ of sand and gravel; the cinders may either be used or not. The gravel selected should not be of a large size.

[Mr. Smith then exhibited the manner of forming the tiles on the ground near the spot where they are to be used. The machine consisted simply of a large box, in the bottom of which were placed the moulds and cores, the box having at each end holes corresponding with the size of the cores at which to draw them out. The moulds being placed in the box, the box was closely filled with the concrete, which was firmly beaten down, and then the substance to form each tile was compressed by instruments adapted to the length of the tile. The cores were then drawn, the moulds and box lifted, and the tiles left behind, requiring only drying in order to be fit for use.]

Mr. Smith continued—

In our district lime is very dear; it costs about £1 per ton in the shell. The cost will be—

One ton of lime	£1	0	0
Half ton of cinders	0	1	0
Four tons of sand	0	4	0
Two tons of gravel	0	5	6
Grinding	0	2	6
Workmanship	0	10	0
	£2	3	0

These quantities will make 2880 tiles, which will be about the rate of 15s. per thousand. I would recommend in all cases that the gravel and the sand should be ground together, as thereby the lime goes much farther. By grinding them, also, in a wet state, they are better prepared to make the mixture which forms the concrete.

A question has been handed to me, as follows:—"What effect have thorough draining and subsoil ploughing on the habit of throwing out the wheat plant by frost?" There is no difficulty in answering this; because it is well known to be owing to the moisture that the wheat plant is thrown out, and whatever removes the moisture, will have the favourable tendency required. I have known many places where almost every winter the greater part of the plants were thrown out. Now, the result of thorough draining and subsoil ploughing is, that they retain the plant perfectly well, and have very abundant crops.

The best of the two modes which I mentioned of forming the tiles, is to make them just where the drain is wanted, and in a few days they will become so dry that they can be placed in the drain. One disadvantage is, that these tiles will not stand carting for a length of time. They require several months before they will admit of being laid one over the other. But, in most instances, the making of the tiles can be accomplished on the spot, and in the course of a few days they may be put into the drain. It is, then, of great importance to cover them immediately with some light soil, free from stones, and to beat them down so as to preserve it from injury. If there are any stones in the soil, they may get down to the tile and seriously injure it.

This is an instrument with which to form the tile in the drains.

[The lecturer then exhibited the method of forming the tiles in the drains, which is done by placing the mould in the place in the drain to be occupied by the tile, then laying upon it the concrete, and after pressure by an instrument similar to that used in the former process, drawing out the mould by means of a long handle attached to it for that purpose.]

Mr. Smith—With reference to the tiles, I would remark that it is better to make them in moist weather than in dry.

A gentleman inquired how long it would be before the drain could be filled in.

Mr. Smith—I consider it completed when the soil is put over the drain. In an experiment which I made in Forfarshire, as soon as the core had been withdrawn, when the soft soil had been beaten over the concrete, it was fit to be walked over in two days after. Having no greater covering than that on it, I jumped myself on the tile from the surface, without doing any injury, so that I consider beating the earth over the tile perfectly secures it from injury, and the moment it is completed it is beyond any danger—one day, at least, after the core is withdrawn.

A Gentleman—If I understood Lord James Hay right, he said it is better not to let the water run through immediately.

Mr. Smith—I should say that precaution was quite necessary; there would be some risk of the lower part being washed and injured. Mr. Littledale, of Cheshire, has also made experiments on the system. I cannot catch his eye, and therefore do not suppose he is here, or he would bear testimony to the advantages of it. The old mode is to have narrow ridges not more than three yards broad, because otherwise there would be no crop at all. There is generally a fringe like a bristle at the top of the ridge, and there is nothing in the furrow below. There is a gentleman who has followed the plan of thorough draining and subsoil ploughing, and has laid down his land flat; and he has succeeded in converting a very sterile clay into a clay which has borne a very splendid crop of potatoes, which he has sold this season for 40*l*. an acre.

I have an interesting communication to-day from Scotland, which, though not immediately connected with the subject before us, bears intimately upon it. There are great doubts respecting the propriety of putting seed deep into the soil, or covering it very lightly. Experiments have been made on that subject, but none so conclusively as that which I have now before me, which relates to the springing up of the more tender seeds, the grass seeds; and it shows the great importance of having a shallow covering over them. This experiment was made by the Messrs. Drummond, of Stirling, the individuals who first introduced the agricultural museums.

This experiment tends to show the great importance of a light covering to grass seeds. I have made a harrow of peculiar construction, which reduces the surface soil very much without tearing up the ground. It has no teeth, but acts by little sharp discs, closely set together, which curve very slightly. I have found this instrument also very efficacious if used as a brush harrow.

A great many questions have been put to me in the course of the lecture, which I have endeavoured to answer as satisfactorily as I could. I now take the liberty of referring to two gentleman, who have had opportunities of seeing what has been done by the application of thorough draining and subsoil ploughing. One of these gentlemen is well known as an eminently scientific man, who has visited my farm, and has obtained information as to what it was in its original state, and to what it has attained by cultivation; I mean Dr. Buckland.

Dr. Buckland—Gentlemen, I am one, I believe, of the few individuals present who have had the opportunity of visiting the scene of these most interesting experiments. I believe the term Dean-stoning has been applied to the process, but "thorough draining" is the designation given to it by Mr. Smith. Every word uttered by Mr. Smith I can verify from my own personal inspection of his farm. I went there disposed to criticise, and there is but one attempt at criticism that I can offer on all I have heard or seen of Mr. Smith; and that is, that he talked just now of making straight lines round the hill. There may be a rule for doing that in Scotland, but it is at present unknown in this part of the empire. I can find no other fault, and I think that what I have said is the greatest compliment I can pay Mr. Smith. I examined the pond which has been spoken of, and I could find nothing there which indicated the presence of earth. Therefore it is quite clear that there is no tendency by any natural process to fill up those drains. A most important point is the total absence of furrows—an advantage which was not so fully pointed out as it might have been. The wetting which you have in the gutter, and the too great dryness which you have on the upper part of the furrow which you have in an ordinary field are avoided, and a healthy condition is assumed over the whole field, whether one or one hundred acres. One fact is better than any criticism which I can offer. On my return I visited Sir Robert Peel, and was conducted by him to see the worst farm on his estate. One of the fields which should have had grass upon it consisted in three-fourths of it of burnt clay, and one half was full of little plashes, which the tenant had covered with rotten dung. It was impossible that the moisture flowing from this could go down; it therefore began to dry, and its whole virtue was going to the wind. Sir Robert admitted the badness of the tenant, and promised to adopt the system I had recommended in one of my pamphlets. I heard no more of the matter till about the end of last autumn, and then I received a letter, which stated that Sir Robert had obtained possession of the farm, and was proceeding to drain it in the manner recommended by Mr. Smith. I hold it very important to get another experiment made in the west of England. I saw—and this shows the connexion of geology with agriculture—what the original condition of the soil was, as there is a small fragment of it over the hedge. Mr. Smith's soil is more than a foot deep, while over the hedge it is not more than three or four inches of the coarsest soil, not worth more than half-a-crown an acre; the value of Mr. Smith's I will not mention, but perhaps 3*l*. or 4*l*. an acre would be a fair guess. Now, Sir Robert Peel has in one year wholly changed this by improving the subsoil; and you shall hear the result sent to Sir Robert by his bailiff, to be transmitted to Mr. Smith. After the land had been drained on Mr. Smith's plan, it was limed with four tons of good lime per acre; it was then ridged up, the ridges afterwards split, and rotten dung put between. It was immediately moulded up, and the seed drilled on the ridge over the dung, so that the seed had the benefit of the dung at the first stage of vegetation. The first crop of turnips produced was four times greater than any crop produced on the same field at any previous time. The manure was good farm-made stable manure and farm-yard dung mixed; the proportion was 12 tons an acre; the best crop was 27 tons an acre; the seed (the Herefordshire white) was sown the 21st of June. The second best (26 tons) was red giant, sown the 23rd of June; the next was red top, sown the 24th of June; and the next the white globe, sown the 25th of June. The whole of the seed was from Skirving's, of Liverpool, and 2½lb. per acre was sown; the ridges were 24 inches distant from each other. That document was signed by Thomas Hill, Sir Robert Peel's bailiff. This is the result of twelve months' experience only, for Sir Robert Peel wrote to me, and said he sowed under unfavourable circumstances, and his neighbours were laughing him to scorn. Whether or not 26 or 27 tons of turnips an acre is a failure, on land which never before produced 6 tons an acre, it is for you to judge. Here is the whole expense repaid in the first year, and the land for ever worth forty shillings an acre.

A gentleman from Berkshire, who had cultivated a portion of Bagshot Heath, spoke highly in favour of Mr. Smith's system, and alluded to that gentleman as having almost taught him the rudiments of agriculture.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.

SECOND COURSE—LECTURE XII.—RAILWAY ESTIMATES.

This lecture had reference to the consideration of estimates, as applied to railways—that is, to ascertain lineal dimensions, superficies, and cubic contents, and, affixing the proper rateable prices, to work out the monied results. The Professor said, that, probably, the most ready way to give a general idea on this subject would be to go briefly over the several heads to be considered in framing an estimate. It was assumed that proper plans and sections of the work had been prepared in a skilful manner beforehand, Mr. Vignoles strongly insisting on the necessity and importance of having all such documents furnished on a much larger scale, and with vastly more attention to accuracy and detail, than had often hitherto been the case, particularly for Parliamentary estimates, observing, that erroneous data and calculations could not but result from a neglect of this rule: and, he stated, that, although many of the standing orders of Parliament were annoying in some respects, yet the principle on which they were framed, went to compel a compliance with forms, in doing which, greater previous investigation and accuracy of plans and sections, became absolutely indispensable.

The *quantity of land* required formed naturally the first item of an estimate. It was but seldom, indeed, that the very small economy of taking land for one line of railway only was adopted. To a given breadth, therefore, for a double line—say, from eight to ten yards—must be added the necessary allowance for fencing and ditching—say, three yards on each side—making a constant breadth of fourteen to sixteen yards of land throughout, independent of the necessary slopes in excavations and embankments; the additional quantity for these, depends, of course, on the depth of the cutting, or height of the bank, in the various places, and on the ratio of the slopes of the earthwork. Suppose, in a cutting or banking of ten feet, this ratio to be one horizontal to one perpendicular, then, such slopes of one to one require ten feet additional breadth of land on each side—together, twenty feet—viz., twice the depth or height to be added as a further breadth, beyond the constant one for the railway and fencing. In like manner, for slopes of one and a half, two, two and a half, or three to one respectively, multiply the varying depths or heights of cutting or embanking by three, four, five or six, as the case may be, for the necessary augmented breadth of land due to the slopes, along their several extents; and thus, from the lengths measured, and the heights figured, on the section, the varying quantities of land are obtained, multiplying length by breadth, and reducing the areas to acres and parts for agricultural districts, and to square yards for land in towns and their immediate vicinities. For the prices to be assigned to these superficial quantities, the engineer must depend on the land valuer, who is also to judge of the amount of contingent damages. On an average, the actual quantity of land for a double line of railway, including the slopes of earthwork, may be taken at ten acres to the mile, but the precise areas must be ascertained in detail in the way explained. The cost of land for many of the leading lines of railway had been as much as £5000 per mile for the whole of their length. The cost of land for lines at a greater distance from the metropolis was less—still, from the numerous contingent after-charges, in respect of land, the sums were large, and had often far exceeded the original estimates.

The *fencing of the land* comes within the province of the engineer, though it is sometimes comprised in the item of land. The mode of fencing must always be regulated upon the custom and materials of the country. Dry-stone walls, earth mounds with furze hedges, posts and rails, quickset hedges, and broad side-ditches or drains, are the principal kinds of fencing through agricultural lands; walls of brick or masonry, set in mortar, are generally called for through towns or building land. The several lengths of each of these are ascertained from the plans; the prices are obtained in the localities. Including farm gates, the cost of fencing varies from 1s. 6d. to 3s. per yard lineal in the country. In the vicinity of towns, for stations, &c., the price will vary from 5s. up to 10s. per yard, according to circumstances, which it must be the business of the engineer to ascertain.

The third item is usually that of *Earthwork*—that is, to reduce the undulating natural surface of the ground to the railway level or gradient, by cutting through hills, and filling across valleys. Mr. Vignoles having, in the first course, entered at large into the consideration of earthwork, thought it unnecessary to say much here. The price of the earthwork depends abstractedly on the average work that an able-bodied man can perform in a day, in various soils—this it should be the study of the engineer to determine. The mere price to the workman, for getting and filling, may be taken at from 2d. to 5d. per cubic yard, for the various kinds of sands, gravels, or clays; and from 6d. to 2s. for harder materials, rock, &c., but, in addition, various other matters are to be provided—barrows, planks, wagons, temporary railways, &c.—the present modern practice in moving large quantities of earth is vastly different to what it was in this country thirty years ago, or to what it still is on the continent, more particularly in the greater distance to which the material is carried; these several distances between the excavations and the points of depositing them, either into embankment or to spoil, must be ascertained from the longitudinal section, and a careful examination on the ground—these distances are technically called *the lead;* for distances under a quarter of a mile, the prices are higher, in proportion, than for longer distances. Taking the average description of soils, and the average distances, 1s. per cubic yard may be taken as a covering first estimate, upon the whole number of cubic yards of excavation or of embankment, whichever may be the larger quantity shown upon the section. The quantities of earthwork in a railway, on an average per mile throughout the whole distance, might be taken as a characteristic of its cost, so far as mere construction went, independent of carrying establishments, stations, and land, over which items the engineers seldom had control. Mr. Vignoles said it would be very interesting to have an abstract of the quantities and cost of the earthwork, distances carried, &c., on all the railways, and indeed, of all the other items of the works, as actually executed; they would become valuable precedents for future estimates, particularly if accompanied by explanations of the circumstances under which the operations were carried on. The great haste with which many of the railways were executed, while the late powerful excitement lasted, had added greatly to the cost, by raising the price of labour. Mr. Vignoles stated that he had already given some such abstracts of the railways that had been executed by him, or under his directions, and he was prepared to give more, and he hoped that other engineers would follow his example, as it could not but be very satisfactory to the proprietors of the different concerns, as well as a justification to the engineers themselves, and to the directors, that they could go into the minutest detail of expenditure. The Professor then gave abstracts, in round numbers, of the quantities of earthwork on many of the principal lines of railway, as well as could be ascertained from the sections. He mentioned the North Union Railway, twenty-one miles long, with 125,000 cubic yards of earthwork per mile, at an average cost of 10¾d. per yard, including all extras and contingencies. The Midland Counties, 57¾ miles, with 100,000 cubic yards of earth per mile, at an average cost of 13d. per yard, including slips and all charges, the soils nearly the same in each, and the average lead nearly alike—viz., one mile—attributing the difference to the great haste and great demand for labour in the latter. The mean of these would be now a fair estimate.

Having estimated for the cost of obtaining the artificial bed of the railway, the next item would be the *Bridging and Masonry*—that is, to restore the previously existing communications of roads, canals, or other railways, the passage of rivers, watercourses, &c., &c., by viaducts, aqueducts, ordinary bridges, culverts, drains, &c., and often by heavy retaining and breast walls. Under this head came the bridges of brick, timber, or iron;—in very marshy countries, where the foundations are likely to be bad, and the drainings liable to be affected, timber may be resorted to, and used in the shape of piling, with cross beams to sustain the rails across the openings, avoiding thus the cost of arches, abutments, and wing walls. The ascertainment of the several superficial or cubic quantities in each of these different constructions, is a matter of simple mensuration from the working drawings. The attachment of prices to these, in all their various details, with sufficient accuracy, depends on the mature judgment and experience of the engineer; and it is by a long course of careful study and observation that the young student, in his employer's office, and on his works, can alone hope to acquire this knowledge. It was but too common, in making estimates, to fall short in this item, particularly in the number of occupation bridges, which, owing to the complicated holdings, improvements, &c., had to be provided for to a vexatious extent, or bought off. The masonry is generally in proportion to the earthwork, and in many cases has happened to be of nearly the same amount of cost. The average number of bridges on a main line of railway might be taken at five for two miles. Diversions and embanked approaches of roads, gravelling or metalling the new surfaces, and the contingent operations, should be separately calculated. They are included under the head of fencing, of earthwork, or of bridging, or kept as a distinct item, according to the practice of the engineer, but they form a large sum, varying from 100*l.* to 500*l.* per mile, according to circumstances, and, in preliminary estimates, are too often omitted, or are put into that refuge for all deficient items—contingencies.

The item of *Upper-Works* in general, or *permanent way*, had been gone into so fully in the recent lectures, that it was not necessary here to do more than mention it, as forming a leading point in considering estimates. It is usual to add 10 per cent. upon all the items of the estimate, properly belonging to the engineer. Besides these were the preliminary expenses of surveys and Act of Parliament. The management, including cost of conveying, &c., and all salaries and expenses of direction, office, engineers, solicitors, &c., &c. Then came the expenditure on the stations, engines, carriages, repairing and building shops, fittings, and all the carrying establishment necessary for passengers, also for goods and for warehouses, wharfs, and other accommodation. It was in them the heavy extra expenditure of railway capital mostly went, and which, in the early stages of the railway system, could no be properly judged of. By way of summary, Mr. Vignoles said he would give, in his next lecture, the actual cost of one or two lines of railway which had come under his direction, and which might be useful by way of reference in making out estimates on other occasions, though the construction and working of railways must be regulated on much more economical principles than had hitherto been the case, or no more of them would be undertaken.

LECTURE XIII.

In continuation of the observations on *Railway Estimates*, which had been commenced in the last lecture, Mr. Vignoles observed that, having therein gone fully into the items of *construction* of railways, he had only glanced at the very necessary provision to be made for the efficient *working* of them—viz., the *Stations and Carrying-establishment*, upon which he would say a few more words, for it was mostly under this head that the chief causes—or, rather, the chief excuses—for extra expenditure, or excess of estimates, had arisen. Properly speaking, this item, so costly, and yet so indispensable, should be taken as falling on a railway company, not as proprietors of the road, but as carriers—the distinction being, that if the railway was let on lease, as canals have been, or if everybody could carry on the railways, as they do on the canals—if, in short, public safety and public convenience, and generally necessary arrangements, did not make it imperative, or, at least, highly desirable, that the railway companies should be carriers (of passengers, at all events), the expense of stations and carrying establishment would not fall on them, though they must still be incurred by some parties, before the railway can be brought into profitable operation; nevertheless, the public, who are to use and be benefitted by the road, having, after all, to pay in one shape or another, are greatly interested in a proper expenditure, any excess of which is sure to be felt in increased charges or in diminished accommodation, until the grievous expenditure of a rival line is introduced. In analysing the cost of *Stations* it is obvious that the land always forms a prominent item, for, being near towns and populous places, it is to be bought by the yard, and not by the acre—building land, villa land, &c., &c., instead of mere fields. Hence, it will not be surprising, if it is found that the cost of the land, for the stations only, on many of the great lines, has amounted to as much as one-third of the whole cost of land for the railway. The *buildings* erected at stations may be divided into three classes—those for the accommodation of the passenger traffic—those for the goods, minerals, &c.—and those for the repair and maintenance of the engines, carriages, &c. At principal towns, therefore, large and distinct establishments must be erected; and, on long lines, a principal central depôt for the engines, is often required in addition. At the minor and road stations the whole may be grouped together under one roof. In no department of expenditure have so many differences, and so much useless extravagance in construction and arrangement, been displayed, as in the buildings at stations; and hundreds of thousands of pounds have been absolutely thrown away from want of sufficient forethought and consideration, and by erecting enormous masses of buildings, either at the wrong places or in an injudicious manner. It was better to wait until the character of the traffic was ascertained, before making such expensive permanent establishments, and then to increase the accommodation by degrees. As an example of a moderate expenditure under this head, Mr. Vignoles mentioned some particular instances, and went somewhat into detail. At the terminus of a railway in a manufacturing town, with 80,000 inhabitants, there had been an expenditure of £9,500. for the passenger buildings, sheds, &c., &c.; £5,500. for goods' warehouses; about £2000. for the mineral traffic; and about £3000. for fixtures, turn-plates, &c.—say, in all, about £20,000. exclusive of the land, which had amounted to a very large sum, upwards of £13,000., including a good deal of spare space, existing buildings, &c., &c. At a smaller town on the line, but with some extent of goods' traffic, the cost for passenger buildings, sheds, &c., was £2500.; for merchandise accommodation, £3500.; turn-plates, fixtures, tools, &c., &c., £1000.; land about £3000. On the same railway the cost of six or seven various minor road stations, including water tanks, coke and engine sheds, tools, &c., was £3500.; land about £1500.; sundries on the whole line about £1000.—being a gross expenditure of £50,000. on station, land, and buildings, for a line of about twenty-two miles, which is at the rate af £2273. per mile; and the corresponding carrying establishment of engines, tenders, &c. (for passenger traffic only), was about £19,000.; for passenger carriages of three classes, horse-boxes, trucks, &c., &c., about £13,000. (the wagons for merchandise, coal, &c., as well as the engines, &c., being provided by carriers on the line, who provided their own carrying stock); and the necessary buildings for repair and maintenance of engines, carriages, &c., with tools, fixtures, &c. &c., about £12,000.—making a gross cost of £44,000., or £2000. per mile. The whole of this concern having been arranged with the strictest regard to economy, may be taken as a fair average, and it will be safe to say, that £4000. per mile for an effective carrying establishment, with the necessary stations, is a moderate sum. For lines of less traffic, if of considerable extent—as, for instance, say for some of the long lines from the present railway termini in the north of England, to either of the principal towns in Scotland, a smaller amount might be sufficient; but Mr. Vignoles considered that it would be unwise to estimate a smaller expenditure than that of £3000. per mile for *Stations and Carrying-establishment*, on a line to be worked by locomotive engines, and it would be much safer to take £4000.; on either of these sums, £1500. per mile for the locomotive stock and buildings must always be estimated, and about £500. per mile for the carriage department—leaving from £1000. to £2000. per mile for the stations, according to the extent of accommodation; keeping the instances of the extraordinary outlay on some of the principal railway lines as examples to be avoided, and not to be imitated, or referred to, as necessary.

Under the last head of *Management*, came all the various and miscellaneous items of expenditure, between the first concoction of the project, to the closing of the capital account. The preliminary expenses of examining the ground, levelling, surveying, maps, &c., and all the formalities in the engineer's department, to enable application to be made to Parliament; the ascertainment of the traffic, revenue, travelling, and other expenses of various kinds, &c., &c., generally undertaken by the secretary; the valuation of land, &c., by the surveyor; the collections of the names of owners and occupiers, notices to them, applications for their assents, &c., and the management of the Bill throughout all its stages, falling to the charge of the solicitor. All these must be incurred before a spade was put into the ground, and had heretofore varied from £500. to £1000. per mile, according to the facilities afforded, the opposition encountered, the length of the line, &c. In future estimates, it was to be hoped this item might fairly be put, as not exceeding the smaller of these sums. Then came the setting out of the line, the detailed levels and surveys, and all the office work of the engineer, until the works are put into the hands of the contractor. The minute valuations of the property to be taken, and the juries, references, conveyancing, stamps, and all the various legal steps until the company are put into full possession. Then the office establishment for regulating all the financial and ministerial affairs, and the temporary arrangements, police, lawsuits, and legal and illegal charges of all kinds, taxes and rates, interest and commission to agents and brokers, travelling expenses, salaries, and a great variety of disbursements of a miscellaneous kind, which, in the aggregate amount to a large sum. The whole of the outlay thus coming under the head of *Management* has varied from 5 to 10 per cent. on the gross cost of the railways hitherto executed, according to their extent, and the amount of capital embarked, and especially according to the degree of vigilance exercised to keep down expenses, which depends chiefly on the director or secretary, or under whatever name the acting manager of the company may superintend. Judging from the examples past, and the deep impression which has been made on the public mind of the necessity of economy in every department, Mr. Vignoles thought 5 per cent. might be estimated hereafter, unless the lines were very short, and the capital small.

In recapitulation, the Professor observed, that the young engineer should always keep in view, for his estimates, the preceding great divisions of the cost—viz., *land*, including the damages, and fencing—*earthwork*—*works of art* (bridging, masonry, &c.)—*upper works* (the permanent railway proper)—*stations and carrying establishment*—*management*—and having, in his first estimates, allowed amply for each of those items under their several heads, he should add at least 10 per cent. for unforeseen contingencies. Some of the preceding items would be common to almost all railways, and others, of course, would vary greatly, according to local circumstances, chiefly regulated by the amount of earthwork; for, as that is heavy, so the works of art become costly, since the works of art are merely to restore the existing communications of the country, and the natural or artificial water-courses and drainage to their state before disturbed, or as near as may be, and that to an extent in exact proportion to the civilisation and improvement of the country, to enforce all which stringent clauses are inserted in the Acts of Parliament, and plenty of persons are always on the watch to enforce them. Mr. Vignoles observed, that the land, levelling of the ground, and restoring of communications, might, on the average, including contingencies, extra land, &c., be taken as forming about 50 per cent. on the total outlay of railways hitherto executed. But, referring to the items the Professor had gone over in detail in previous lectures, it appeared that, when proper economy and circumspection was used, the necessary cost of the railway proper—that is, the necessary quantity of land for the road only, a good substantial set of upper works for a double way, and a complete and effective carrying establishment—might, and had been, obtained for £10.000. per mile. All beyond is expenditure to obtain gradients, more or less perfect, and Mr. Vignoles thought that the great error all engineers had hitherto committed, the cardinal mistake—of which he himself was far from guiltless—was, seeking to make railways, intended, as they were, chiefly for passengers, *too perfect*—that is, of cutting down hills, and filling up valleys to too great an extent, on the erroneous supposition that the engines were always to carry *maximum* loads, which was very seldom the case, and never would be so on lines at a distance from the metropolis, particularly such as the lines into Scotland, previously mentioned. In short, the Professor insisted that the engineer should, in such instances, and for the cross railways, which he yet hoped might be introduced, make the gradients and curves much less theoretically perfect; and that the amount of expenditure, beyond the above stated necessary one of £10,000. per mile, should be reduced to the very *minimum*; and he considered that henceforth an average of £15,000. or £16,000. per mile, and a *maximum* of £20,000., or, in very extraordinary cases, indeed, of £25,000., should be looked to for the construction of double lines of railway in any country, but that in most cases, of light traffic, and consequent adaptation of gradients, for single lines, a sum of from £7000. to £12,000. per mile would be the limit of total expenditure. Mr. Vignoles concluded by observing, that the preceding abstracts were deduced from very detailed accounts, which had been arranged on a uniform system, and kept from the very commencement of each undertaking, so as to be available, at any time during the progress of the works, to show the exact state of the expenditure; and had been finally worked out to the nearest thousand pounds, as above. And the Professor expressed his great hope and expectation that this example would be followed, and that similar accounts would shortly be forthcoming, of the corresponding items of cost on all the principal railways in this and in other countries, more especially where complaints of improper excess of expenditure over estimates (well or ill-founded) had been charged, for the publication of such accounts—and the more in detail the better—would be the most complete defence of the directors, and the most satisfactory explanation from the engineer, and alike valuable, as statistical information, to the country—as salutary guidance to the capitalist and speculator—and as valuable information and warning to the old as wel as to the young practitioner.

The preceding is a very brief outline of this interesting lecture, and the following, we believe, is a correct abstract of the cost of the two railways quoted by Mr. Vignoles.

Comparative Abstract of the Cost of two Principal Lines of Railway, under the general heads of Expenditure, as deduced from the very latest accounts of Actual Expenditure, brought out to the nearest round numbers:

MIDLAND COUNTIES RAILWAY. [57¾ MILES.]				— —	NORTH UNION RAILWAY [25 MILES.]			
Pr. cent whole cost.	Cost pr. Mile. £	Total Cost. £	— — —	Heads of expenditure.	— — —	Total Cost. £	Cost pr. Mile. £	Pr. cent whole cost.
12	3463	200,000	.. (790 acres)	Railway land, and damages ..	(320 acres)	50,000	2000	8
3½	1004	58,000	.. .. ..	Fencing, gates, roads, &c.. . . .	.. .. ..	20,000	800	3½
18½	5455	315,000	(5,700,000 cubic yards)	Earth work	(2,900,000 cubic yards)	125,000	5000	20½
15	4364	252,000	.. .. [tons	Works of art, of all kinds. . . .	.. .. ..	125,000	5000	20½
23	6822	394,000	Upper Works £215,000—(17,670)	Iron rails and chairs	(6885 tons) £68,000 Upper works	130,000	5200	21
			179,000 ..	All other materials, and labour	.. 62,000			
21	6147	355,000	Stations and carrying establishment. £ 51,000	Station land, and damages ..	£ 18,000 Stations and carrying establishment.	100,000	4000	16½
			168,000	Buildings, fittings-up, &c.. . . .	48,000			
			75,000	Engine, &c. stock	20,000			
			61,000	Carriage, &c. stock	14,000			
7	2182	126,000	.. .. ..	Management, law, interest, &c.	.. .. ..	60,000	2400	10
100	29,437	1,700,000	— — —	.. Totals ..	— — —	610,000	24,400	100

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ACADEMY OF SCIENCES.

June 20.—A paper by M. Vicat was read, "*On the nature of Pouzzolanes.*"—M. Vicat, having discovered the nature of the substance, has been able to compose a substitute with pure clay, calcined whilst exposed to a dead heat, so as to get rid of eight or nine-tenths of the water combined with it. The best clay for the purpose, says this gentleman, is pipe-clay; and in proportion with the admixture of iron, manganese, carbonate of lime or sand, is the defect of quality.

M. Degousée gave an account of some recent results in the making of *Artesian wells*. He states that he has bored for water in the plateau which extends from Lagny to the forest of Arminvilliers, at the height of 110 metres above the Marne. In one spot an abundant supply of water rushed out, although he had gone to a depth of only nine metres. With M. Degousée's report he forwarded to the Academy a letter which he had received from Aimé-Bey, the director of the mines of Egypt, who announces his intention of re-opening some of the bored wells of the ancients, at the foot of the Libyan chain, and requests that the necessary instruments may be sent out to him for that purpose.

June 27.—*A paper on the effect of oil in calming the waves of the sea.* By M. Van Beck.—M. Van Beck thinks, with Franklin, that the phenomenon may be explained by admitting that there exists between air and water a certain natural affinity or adhesion. Water, he says, takes in with avidity the air with which it comes in contact, so that it is with difficulty expelled. It results that, whilst a current of air passes over the surface of the water, the air attaches itself to the liquid, and creates small waves, which, as the wind increases, become large and dangerous. As soon as these waves are covered with a membrane of oil, the adhesion of the air upon the water ceases to exist, and the surface is no longer disturbed.

A communication was read from M. Combes, on the *thermal springs of Hamam-Escoution*, on the Banks of the Raz-el-Akbar, in Algeria, about thirty leagues from Bona. The waters of these springs, which rise in the midst of a plain from little conical domes formed by themselves, are sulphureous, and of the high temperature of 80° of Réaumur.

July 4.—A paper was read "*On the Geological State of the southern part of Brazil, and on the Heavings-up of the Earth, which have at various periods changed the appearance of the country,*" by M. Pissis. The ground examined is situated between the 12th and 27th degrees of central latitude, and comprehends the space between Parana, San Francisco, and the sea. Three periods of rising or heaving up are perceptible in Brazil, the last belonging to the end of the tertiary period. The immersion of certain strata placed at the bottom of the province of Bahia, and a slight elevation of the table lands, found between the sea and San Francisco, have been the results of it.

"*On the action exercised on the surface of various Liquids, by the influence of the Vapour of certain Substances, and by their immediate contact.*" By M. Dutrochet. Light bodies placed on the surface of the water are repelled to a certain distance by the vapour of camphor, of ether, or even of alcohol, and the essential oils. M. Dutrochet's experiments oppose the opinion hitherto received, that this phenomenon is due to the impulsion which results from the rapid expansion of the vapour, which, striking on those light bodies, produces the removal of all the liquids subjected to the experiments. Ether is the one which produces the most vigorous movement of light bodies placed on water, mercury, and several acids and alkalies, but the movement is not always a repulsion, and is subject to great variation. Thus the vapour of ether attracts flour of sulphur placed on the surface of sulphuric acid, and produces a repulsion on the surface of nitric acid. If water be added to these acids, the movement is weakened in proportion as the quantity of water is increased. M. Dutrochet attributes these different movements to a modification of capillary attraction. He observes that, in reality, there is neither attraction nor repulsion in the floating bodies, that their disp[illegible] impedes the current, of which the surface of the liquid is the se[illegible] has its origin in the heaving up or depression below the liq[illegible] reduced to steam.

July 18.—A paper was read by M. Rame[illegible] *heat of plants*. M. Rameaux has ascertained not only according to the external temperature, but also in the different portions of the plants. This he attributes to the flow of the sap, which, having received the vital heat from the direct action of the sun's rays, carries it as it flows; consequently, the portions immediately under the influence of the sap have a higher degree of temperature than those which are most distant.

Another report was made to the Academy, *on the cuirass of cotton felt*, as a means of defence in war. In the first report to the Academy, the conclusions of the commission were not altogether favourable; for, although it was admitted that the cuirass resisted the action of pistol balls, it bore traces of injury from the concussion to which it was exposed. In the present instance, it appears that the cuirass was exposed to a severe test, by being fired at with cavalry pistols, at the distance of a few paces, and that it effectually resisted the balls.

July 25.—A paper was read by M. Vallée, "*On the mode of rendering the Lake of Geneva subsidiary to the Rhone.*" Amongst the phenomena presented by the Lake of Geneva is one which has particularly attracted the attention of M. Vallée, viz. the sudden changes of level which in the country are called *séches*. He attempts to account for this phenomenon by supposing the existence of a subterranean lake, communicating on the one side with the Leman, and on the other with the high valleys by means of natural wells, which are nearly vertical. In this way he endeavours to explain the rising and falling of the waters at Geneva, which have been frequently noticed to vary as much as two metres at a time, and to account for the rapid and extensive changes which occur in the temperature of the lake.

August 1.—M. Bessel, of Kœnigsberg, and Professor Erman, of Berlin, were present. Each read in French a communication to the Academy. The paper by M. Bessel was on the laws of *atmospheric refraction* as connected with astronomical observations. The paper by Prof. Erman was a report on a meteorological voyage of circumnavigation. In the course of M. Erman's expedition round the world, the vessel in which he was, passed four times from latitude 50° north to 58° south, and during this transition M. Erman made observations with the barometer six times a-day. He states from them that, in general, the pressure on the barometer goes on diminishing very slowly from the equator to the poles, and what proves that this depends on the general constitution of the atmosphere, is the fact that the diminution is constant and regular. Thus in the waters of Cape Horn, as well as on the coasts of Kamschatka, the mean height of the barometer is twelve millimetres lower than the mean height of the great equinoctial ocean. Hence it follows, says M. Erman, that the pressure of the air is not the same on basins of the same level in vast seas. M. Erman concludes, from the result of his observations, that a hope may now be reasonably entertained of becoming fully acquainted with the general law of the distribution of the air over the surface of the globe, so far as that law may appear to depend on pressure.

A report was read by M. Dufrenoy, on a communication from M. Amédée Burat, respecting the position of the coal veins in the basin of the Saône-et-Loire. The veins are not in strata, and they exceed in thickness all others known, but the veins are less continuous than in other coal districts in their direction and inclination, are mixed with clay, and he concludes that they have been formed by a vegetation on the spot, periodically destroyed by the rising of the neighbouring waters beyond their ordinary level.

Aug. 8.—M. Arago gave an analysis of a paper by M. de Ruolz, on *the means of fixing one metal upon another by the galvanic process.* When the first paper of M. de Ruolz, on this subject, was read, the practical use of the discovery had gone no further than the precipitation of pure metals, and it remained to be ascertained whether mixed metals could be precipitated. This M. de Ruolz has done, and several specimens covered with a precipitate of copper and tin, in the proportions which constitute bronze, were submitted to the Academy. The red tint of copper, so offensive to the eye in objects of art produced by the galvanic process, has given place to the more delicate and pleasing appearance of bronze. The various advantages of the galvanic system are fully shown in the paper of M. de Ruolz. A precipitated coating must always be more regular and uniform than one laid on by hand. It can be made to any degree of thickness, and cannot be detached from the material to which it is applied. Iron roofs, for instance, both as to frame-work and sheet-iron, may be coated so as to resist the action of the atmosphere, and this without any great augmentation of cost, for the coating may be thin, and the iron work itself, not being exposed to atmospheric action, may be made much lighter. For domestic purposes, the galvanic process as regards a leaden envelope, may be advantageously employed in various ways, and M. de Ruolz suggests that it would be well to employ it for iron shot, which undergoes great deterioration from exposure to the atmosphere.

A letter was read from M. Agassiz, who has been for some time encamped on the summit of the Aar, for the purpose of studying the phenomena of the glaciers. He writes that the mass of ice in that part advances towards the valley at the rate of 220 feet annually, and the surface loses 7 feet of ice every year, which loss, however, finds its compensation in the infiltrations which become frozen, and raise the base.

Aug. 15.—M. Dumas placed before the Academy some specimens of the power of *the newly-invented roller*, by M. Schatteamann, which, according to a former report, has been used with great effect in compressing together into one solid mass the fractured portions of the stones used for macadamizing roads. The specimens now submitted to the Academy are of two kinds. In the one the interstices of stone are filled with sand, so compressed as to become as solid as the stone itself; in the other, fragments of stone are rolled together, and form the most complete cohesion.

Aug. 29.—A further communication was read from M. Agassiz. M. Agassiz informs the Academy that he has ascertained that the glacier is throughout mined and sapped by watercourses, as he was convinced, from experiments which he had before performed, and of which he had given an account, that ice is porous in a high degree, and that the motion of glaciers is due in part to the infiltrations of water through the mass, thus undermining the base; and that the experiments on the glacier of the Aar have established the truth of this theory. M. Agassiz also mentions a fact which tends to corroborate what has been stated as to the phosphorescence of clouds. He mentions that it is more easy, on the glaciers at night, to distinguish the hands of a watch when the sky is covered with clouds, than when it is cloudless and the light of the stars is seen. He also states that the appearance of a peculiar snow, well known to all visitors of the glaciers, is not a snow that falls, but merely a modification of the frozen surface.

In a paper lately read on some remarkable circumstances connected with the *Daguerréotype*, it was stated that a cameo having been suspended so as to hang near, but not to touch, a polished plate in a box from which all light was excluded, the engraving of the cameo was clearly and distinctly marked on the plate. M. Breguet, the celebrated watchmaker, has addressed a letter to the Academy, in which he states that he has frequently seen, on the polished inner surface of the gold cases of his flat watches, the name of his house plainly and legibly marked, the impression having been received from the engraved letters of the covering of the works, which did not touch the case.

Sept. 5.—A communication was read from M. Vallé, a colour-maker, on the employment of a *solution of caoutchouc for canvas* used by painters. M. Vallé was led to the researches which have terminated in the invention which he has submitted to the Academy, by observing the injury caused to the works of some of the greatest masters by the influence of the atmosphere upon the canvas. M. Vallé's method of preparing the solution is at present a secret. Although applied to both sides of the canvas, it leaves it sufficiently elastic to prevent cracking, and secures it against the action of the atmosphere. To this discovery he adds that of a peculiar kind of varnish for the painting, and thus he defies the ravages of time.

The subject of *the meteors commonly called shooting or falling stars*, was alluded to. According to the last communications from M. Arago, the period between the 10th and 12th of August still retains a marked superiority for this phenomenon, which is still so little understood. M. Littrow, of Vienna, counted, on the night of the 10th of August, 129 of these meteors per hour. On the same night M. Bonard, of Rennes, counted 44 per hour; at Tours, and in the department of the Doubs, M. Laugier and M. Mauvais witnessed a shower of these meteors. At Paris and at Toulouse the observations of M. Eugène Bouvard and M. Petit were attended with less marked results, but still they were sufficient to prove that the period of the year above named is that in which the phenomenon abounds. In a communication to the Academy, M. Bourdot, of Grand-Lemps, in the Isère, states that he watched with great attention the passage of these meteors on the night of the 11th ult. In no instance, when they exploded, did he hear any noise, but the explosion was, in several instances, followed by a long train of phosphoric light.

INSTITUTION OF CIVIL ENGINEERS.

April 26.—The President in the Chair.

"*A description of a new arrangement for raising Ships of all classes out of water for repair, proposed to replace the Graving Dock or the Patent Slip in certain situations; with observations upon the other methods used at different periods for this purpose.*" By Robert Mallet, M. Inst. C. E.

This communication describes an apparatus proposed by the author as a substitute for the graving dock or the patent slip, in situations where such constructions would be too expensive, or an inappropriate locality prevents their adoption. It reviews the principal methods hitherto in use—such as stranding by bilge-ways, careening or heeling over, lifting by the camel, the graving dock, the floating dock or caissoon, the screw and the hydraulic docks (both American inventions), and Morton's patent slip; it enumerates the localities for which each of these inventions is most applicable, and then gives the objections to them. The author then describes the general principle of his invention to be, the diffusion of the load or strain over the greatest possible number of fixed points, avoiding casual and unequal strains; that there should be uniform motion, with a power proportioned to the resistance. In providing for this, the joggle-joint is used throughout. The machine consists of a platform, supported upon a series of frames with joints at each end, attached at the lower extremities to fixed points in the foundation, and at the upper ends to the under side of the platform, which is traversed by a series of beams, to the ends of which are fastened rods connected with rollers, working in grooves along a suspended railway on the cantilevers of two jetties, which are built to form the sides of the apparatus. A chain connected with all these rollers traverses in each suspended railway groove, and the power of a steam-engine and wheel-work, being applied after the vessel is floated on the platform and made fast, the frames raise the platform and vessel together gradually out of the water, permitting free access all round the ship; and when the repairs are completed, the whole is again lowered into the water. It is contended that many practical advantages would arise from this system—that the ship would not be strained, that time would be gained, and that it is superior to the ordinary methods now practised. The calculations of the leverage, the division of the load over the fixed points, &c., are given in detail, and the paper is illustrated by a series of elaborate drawings and a complete model of the apparatus.

Remarks.—Mr. Rendel thought that credit was due to Mr. Mallet for the science and the practical skill combined in the production of the contrivance under discussion; it was perhaps imperfect in some of the details, but he was inclined to believe that, in certain situations, and for vessels of moderate size, it might be adopted. Its construction would certainly be more expensive than that of a patent slip, but it would be less costly than a graving dock, and not liable to injury from hydrostatic pressure, to guard against which frequently constituted a main portion of the expense of a graving dock. The foundation of this structure might be simple, as the weight was distributed over so many points; he conceived, however, that unless it was established where the rise of tide was considerable, the foundations must be laid at a depth of 5 or 6 feet under low-water mark, to allow for the thickness of the frames and the platform beneath the ship's bottom. He was of opinion that a modification of the plan might be advantageously employed for canal lifts.

Mr. Hawkins agreed with Mr. Mallet that a ship must be strained while on a patent slip, because the timbers were all bearing a weight at an angle; but more particularly when leaving the slip, as the stern floated whilst the stem was still on the cradle of the slip.

Mr. Palmer did not admit the advantages of the proposed plan over graving docks, for, as they are now constructed, they possess every requisite convenience for examining and repairing vessels; the gates are made to exclude the water perfectly, and the machinery for pumping is so effective, that a very short time suffices to lay the dock dry. The plan might possess some advantage over Morton's slip in retaining the vessel in a vertical position, but it would be more expensive to construct, and he was not at all convinced that the objections urged against the patent slip were well founded.

Mr. Gordon observed that the position of a ship upon a patent slip was exactly that in which it was built; he could not therefore understand why it should be so very injurious; besides, if the stern cradles were elevated, as was the case on some of the slips proposed by Captain Brown, the vessel remained nearly on an even keel. Another improvement introduced by Captain Brown was, substituting solid rollers for the wheels of Morton's slip, the axles of which frequently twisted and prevented the progress of the vessel. Among the modes of examining the bottoms of vessels enumerated by Mr. Mallet, he had omitted the "gridiron," which consisted of a strong frame of horizontal timbers resting upon the heads of piles a little above low-water mark; over this frame the vessel was moored, and on the tide receding was shored up, resting upon chocks. When it was dry the bottom could be examined, and any slight repair made before the returning tide floated the ship off. "Gridirons" existed at Liverpool, at Hâvre, and at many other ports.

The President observed, that, like the form of breakwaters, much depended upon locality. Where timber was cheap, and the rise of tide considerable, the plan might be applicable; at Liverpool, where the tide rose 30 feet, and in the Channel Islands, where the rise was 40 feet, the platform might be 10 feet above low-water mark, and still accommodate any ordinary vessel. It certainly appeared to avoid some of the main expences of the graving dock, in which so many precautions must be taken for preventing the springs rising and blowing up the bottom. The Institution was much indebted to Mr. Mallet for the great pains he had bestowed on the communication, for the complete drawings and model illustrating it (which were presented to the Institution), and he deserved credit for the ingenuity displayed in the contrivance.

"*Account of the Machinery and Apparatus for compressing and using Gas for Artificial Illumination at the Portable Gas Works of London, Edinburgh, Manchester, and Paris.*" By Charles Denroche, Grad. Inst. C. E.

This paper gives an account of the improvements introduced by Mr. David Gordon into the syphon forcing-pumps, reservoirs, &c., whereby the requisite degree of compression was obtained for rendering gas portable for the purposes of illumination, and of the arrangements adopted in the works at Edinburgh, Manchester, London, and Paris. A description is given of the various kinds of apparatus which were tried before a pressure could be obtained of 30 atmospheres, or 450 lb. per square inch. The portable lamps, with their ingeniously contrived graduated cocks are also described, with the several parts composing the apparatus. It appears that, owing to the cost of compression, which was 3*s.* 6*d.* per thousand cubic feet, and that of delivery, which amounted to 10*s.* per thousand cubic feet, the speculation was unsuccessful in a mercantile point of view, although most of the mechanical difficulties were overcome. The paper was accompanied by a series of detailed drawings of every part of the apparatus.

May 3.

"*Description of the Tunnels, situated between Bristol and Bath, on the Great Western Railway, with the methods adopted for executing the works.*" By Charles Nixon, Assoc. Inst. C. E.

The works described in this paper comprised a large quantity of heavy earth-work in tunnels, &c.; they were commenced in the spring of the year 1836, and terminated in the year 1840. The whole of the tunnels are 30 ft. in height from the line of rails, and 30 feet in width; they are curved to a radius of about 120 chains; the gradient of that part of the line is 4 ft. per mile. The strata through which they were driven consisted generally of hard gray sandstone and shale, with the gray and dun shiver, &c.; in a few places only, the new red sandstone and red marl were traversed. Every precaution was taken for securing the roofs, by lining them with masonry where the nature of the strata demanded it, and in some places invert arches were turned beneath. Driftways were driven before the tunnels were commenced, and shafts were sunk to enable the work to proceed at several points simultaneously. The modes of conducting the works by these means are fully described, with all the difficulties that were encountered. The construction of the centres is given, with the manner of lining the arches with masonry, which is stated to be what was termed "coursed rubble;" but was of a very superior description, and in every respect similar to ashlar-work. The author offers some remarks with regard to the expense of working tunnels by means of centre driftways. He states this plan to be costly, and in many instances without corresponding advantages, on account of the difficulty of keeping the road clear for the wagons. He recommends that when driftways are used, they should be on the lower side of the dip of the strata, as the excavation would be facilitated, and the road would be kept clearer. In long tunnels he has found the cheapest and most expeditious mode of working to be by excavating the centre part from shafts, and both the ends (together if possible) from the extremities after the open cuttings are made. The drawing accompanying the paper gave a longitudinal section of all the tunnels, and showed to an enlarged scale several transverse sections of them, where the variations of the strata rendered either partial or entire lining necessary.

Remarks.—In answer to questions from Mr. Vignoles and other members, Mr. Nixon explained that the extra number of shafts had been required in order to enable the works to be completed within a given time; there had not been any accidents during his superintendence, but subsequently one of the shafts had collapsed. The cost of driving the driftways, the dimensions of which were 7 feet wide by 8 feet high, was ten guineas per yard lineal. He then described more fully his proposed plan of cutting the driftways on the lower side, instead of the centre of the tunnel, and stated the advantages chiefly to consist of a saving in labour and gunpowder, as a small charge sufficed to lift a considerable mass of rock when acting from the dip; the road was also less liable to be closed by the materials falling into it when the enlarged excavation proceeded from one side instead of upon both sides.

Dr. Buckland, after returning thanks for his election as an honorary member of the Institution, expressed his gratification at the prospect of a more intimate union between engineering and geology, which could not fail to be mutually beneficial, and cited examples of this useful co-operation in the cases of railway sections, and models that had recently been furnished by engineers to the Museum of Economic Geology. He then proceeded to remark upon the geological features of the South-Western Coal Field near Bristol and Bath, which had been described by Mr. Conybeare and himself, in the Transactions of the Geological Society of London (1824). Some of the tunnels near Bristol are driven in the Pennant Grit of the coal formation, where it is thrown up at a considerable angle, and composed of strata yielding slabs and blocks of hard sandstone used extensively for pavement. In traversing such inclined and dislocated strata, the engineer's attention should, he conceived, be especially directed to the original joints that intersect the beds nearly at right angles to their planes of stratification, and also to the fractures produced during the movements they have undergone. These natural divisions and partings render such inclined stratified rocks unworthy of confidence in the roof of any large tunnel, and liable to have masses suddenly detached. Inclined strata of a similar sandstone are perforated by many tunnels on the railway near Liège, in nearly all of which the roofs are supported by brick arches. It has been found impossible to make the tunnels through Lias and Red Marl without continuous arches of masonry. In any of the tunnels which have been carried through strata of the great oolite, the parts left unsupported by masonry would, in his opinion, be peculiarly liable to danger, because even the most compact beds of oolite are intersected at irregular intervals by loose joints at right angles to the planes of the strata, and occasionally by open cracks; and it is to be feared that the vibration caused by the railway carriages would tend eventually to loosen and detach these masses of stone. He apprehended still greater danger would exist in tunnels cut through the loosely jointed strata of chalk, unless they are lined throughout with strong masonry; and even that, in a recent case, had been burst through by the weight of the incumbent loose chalk coming suddenly upon the arch. In open cuttings through chalk, where the numerous interstices and the absence of alternating clay beds prevent any accumulation of water, there is little chance of such frequent landslips as occur where [illegible] stone, gravel, or sand rest on beds of clay; but until the side wa[illegible] are reduced to a slope at which grass will grow, they will [illegible] tinual crumblings and the falling down of small fragm[illegible] continual expansion and contraction of the chalk, und[illegible] of atmospheric agents, and chiefly of frost. In o[illegible] inclination of the strata is towards the line of rails, the slope should be made at a greater angle than if the strata inclined from the rails; if this be done, fewer landslips will occur from accumulations of water between the strata thus inclined towards the rails; and such slips may be further guarded against by minute and careful observation of the nature of the individual strata, and a scientific application of subterranean drains at the contact of each permeable stratum with a subjacent bed of clay. Tunnels can be safely formed without masonry in unstratified rocks of hard granite, porphyry, trap, &c., and in compact slate rocks; also in masses of tufa, such as cover Herculaneum, and are pierced by the grotto of Pausilippo near Naples; but in his opinion, wide tunnels driven in stratified rock could not be considered secure unless they were supported by arches.

Mr. Sopwith confirmed the remarks on the importance to the civil engineer of a knowledge of the geological character of the strata through which tunnels or open cuttings were to be made; the cost was materially affected, as well as the stability of the works. The angle of inclination and the lines of cleavage should be carefully studied; on one side of a cutting the slope might be left steep, and all would be firm and dry; whilst on the other, if the same slope was adopted, all would appear disintegrated and wet, and a series of accidents would be the necessary consequence. He could not sufficiently urge the importance of a more intimate connexion between the geologist and the engineer.

In answer to a remark by Mr Farey on the apparent advantages of Frazer's centres for tunnelling, Mr. Bull promised to procure for the Institution an account of the execution of some work with them.

"*An account of the Railroad constructing between Liège and Verviers, Belgium.*" By Lieutenant Oldfield, Assoc. Inst. C. E.

The materials for this communication were drawn from the memoranda made during a tour by the author, who is an engineer officer in the service of the East India Company. It describes the general course of the railway, descending by the long inclined planes, from the height above Liège to the valley of the Meuse, its progress along the banks of the Vesdre, through tunnels, and over almost innumerable bridges and viaducts, to Chaudfontaine, and thence onward through the town of Verviers, in the direction of Aix-la-Chapelle, to the frontiers of Germany. The modes of excavating the tunnels, and the materials used in the other works on the line, are accurately described; the general acclivities and curves of the road, the rails, chairs, and methods of fastening them to the sleepers, and the prices of labour and materials, are all given in detail, and the whole was illustrated by enlarged diagrams from the author's sketches.

May 10.—The President in the Chair.

"*Description of a Flax Mill recently erected by Messrs. Marshall and Co. at Leeds.*" By James Combe, Assoc. Inst. C. E.

The mill described in this communication consists of one room, 396 feet long by 216 feet wide, covering nearly two acres of ground. The roof is formed of brick groined arches 21 feet high by 36 feet span, upon cast-iron pillars: an impermeable covering of coal-tar and lime is laid on a coating of rough plaster over the arches, and upon that is a layer of earth 8 inches thick, sown with grass. This immense room is lighted and ventilated by a series of skylights 13 feet 6 inches diameter; one at the centre of each arch. A vaulted cellar with brick pillars extends under the whole of the building, and contains the shafts for communicating the motion from a pair of engines of 100 horses' power, to the machinery in the mill; the flues and steam cases for warming and ventilating; the revolving fan for urging the air into the room, with the gas and water pipes, and the remainder of the space is appropriated for warehouses.

The heating and ventilating are effected by a large fan, which forces the air through the pipes of two steam chests, each 10 feet long, and containing together 364 pipes of $3\frac{1}{2}$ inches bore: the temperature can be regulated by the quantity of steam which is admitted into the chests, or by allowing a portion of cold air to pass by without traversing the pipes; valves and doors in the flues permit any temperature which is desired to be obtained, or that degree of moisture which is essential for some part of the process of working flax. The general details of the construction of the building are given with the dimensions of the brick and stone work; the cast-iron pillars and caps, the wrought-iron tie-bars, with the reasons for adding a second set after the accident occurred to the first set; the mode of drainage from the roof; and the striking the centres of the arches, &c.

The total cost of the mill including the ornamental stone front was £27,443, which is stated to be about the same cost as that of a good fire-proof mill on the common plan; but as this mode of construction was novel to the workmen, it is probable that a second building of the kind would be less expensive. The advantages resulting from the plan are, convenience of supervision, facility of access to the machines, the power of sustaining uniformity of temperature and moisture, the absence of currents of air which are so objectionable in other mills, the simplicity of the driving gear, and the excellent ventilation which is so desirable for the health of the work-people.

The paper was illustrated by two drawings with a sheet of reference, and an appendix contained the result of some experiments upon the strain on the tie-bolts, the pressure on the arches, and the deflexion of the bolts, &c.

Remarks.—Mr. Smith, of Deanston, was much pleased to find this description brought before the Institution, as he was the first to adopt it for a weaving shed of the extent of half an acre; the columns for carrying the arches were 30 feet six inches apart, and the skylights were 8 feet in diameter; some of the arches were of brick, with stone springers; others were entirely built with rubble stone well grouted, which latter mode of construction he found succeeded quite as well as brick: the settlement of the arches on striking the centres after standing four days was only $\frac{3}{4}$ths of an inch: The arches were thickly plastered with common mortar and at first were only covered with a coating of boiled coal-tar pitch, and lime $\frac{3}{8}$ths of an inch thick, but as the wet penetrated, the thickness of coal-tar pitch was increased to $\frac{3}{4}$ths of an inch, with a mixture of sharp sand, which had proved perfectly water-tight: for some months there was an appearance of moisture, which proceeded from the interior of the brickwork, as it could not escape outwards on account of the impermeable covering; after some time the copious ventilation carried off this moisture and the building became perfectly dry. Over the coal-tar a thickness of earth is laid, which is cultivated, and has proved a prolific garden: in severe weather the frost has not reached above $1\frac{1}{2}$ inch deep in the soil, while it has penetrated to the extent of 12 inches in other situations. The construction of the floor is peculiar: it is desirable in such weaving sheds to have a boarded floor, to prevent the small parts of the machinery from being broken by falls, and also on account of the health of the persons employed; but the vibration of an ordinary wood floor is objectionable. In order to meet these views, a bed of concrete was laid throughout the building, a series of small deal spars $1\frac{1}{4}$ inch deep by one inch wide were set flush into the concrete whilst it was wet, and the whole surface was smooth plastered: upon this bed, when it was perfectly dry, a floor of boards $1\frac{1}{4}$th inch thick was nailed to the spars: it was found to combine the solidity of pavement with all the advantages of a wood floor, and there had not been any symptoms of dry rot: which might be attributed to there being no cavities left beneath the boards, the whole being firmly bedded down. The ventilation was effected by tunnels beneath the floor, the covers of which were pierced with a number of small holes to spread the air. The warming was accomplished by means of hot water circulating under the pressure of the atmosphere only, in "tubes of tin plate" 4 inches diameter; the temperature was very regular and perfectly under control. With one ton of coal per week the shed could be kept up to 70° during the winter. The cost of this building was 30 shillings per square yard of area covered, which was less than the cost of Messrs. Marshall's mill, but building materials were much cheaper at Deanston than at Leeds. He expected that this mode of building would become more general as it combined many advantages, and whatever might be the first outlay in purchasing ground, the cost of which was the only inducement for constructing buildings of several stories in height, it would be fully compensated by the facility of superintendence alone, as in manufactories this was of the utmost importance. These buildings would, he believed, be eventually used for agricultural purposes, and when engineering knowledge was more directed to the processes of agriculture, good results might be anticipated: his attention had been particularly directed to the subject, and he was convinced of the necessity of concentrated superintendence which is not at present possible in the separate farm-steadings as they are now constructed: this might be apparently foreign to the subject before the meeting, but the range of engineering was so wide that it was difficult to say where it should stop.

Mr. Lindsay Carnegie as a landed proprietor could bear testimony to the importance of the connexion of engineering with agriculture, and to the advantages already derived from the improvements which had been introduced by Mr. Smith, who might be justly termed the father of the improved system of agriculture in Scotland.

Mr. Marshall explained that he was indebted to Mr. Smith for the suggestion of this mode of construction, which he had not hesitated to adopt although all the plans had been prepared for mills of several stories in height—he had been convinced of the superiority of the present plan and his expectations had been fully realized. There were of course some difficulties to be overcome and some experiments to try, all of which had not been successful, but in all the essential points this kind of building was superior to any other. An equality of temperature and a facility of imparting a certain degree of moisture to the air which was indispensable for spinning yarn had been perfectly attained.

Mr. Braithwaite inquired whether the arches were found to be perfectly water-tight? On some of the railways which were laid upon arches it had been found that asphalte had failed in rendering them impervious, and they were consequently useless, even for store-houses.

Mr. Marshall explained that a few leaks had occurred, particularly near the skylight-frames, but they had been easily repaired and were now water-tight.

Mr. Combe found that a mixture of finely-sifted engine ashes with the coal-tar pitch was better than lime. The depth of soil above the arches should be sufficient to prevent the heat of the sun from penetrating through the cracks to the pitch and forcing it up. He had recently examined the roof carefully and could only discover six indications of moisture penetrating; these had been easily repaired and all was now perfectly sound.

Mr. Field agreed with Mr. Smith in his estimation of the advantages of carrying on all manufacturing processes as much as possible under one roof and on one floor—great economy of time and labour would result, especially where heavy masses such as parts of machinery required to be moved about —he would always adopt the system in constructing a manufactory.

Mr. Smith observed that an arched roof would be found as cheap as one of wood and slates, and in the relative durability there could be no comparison.

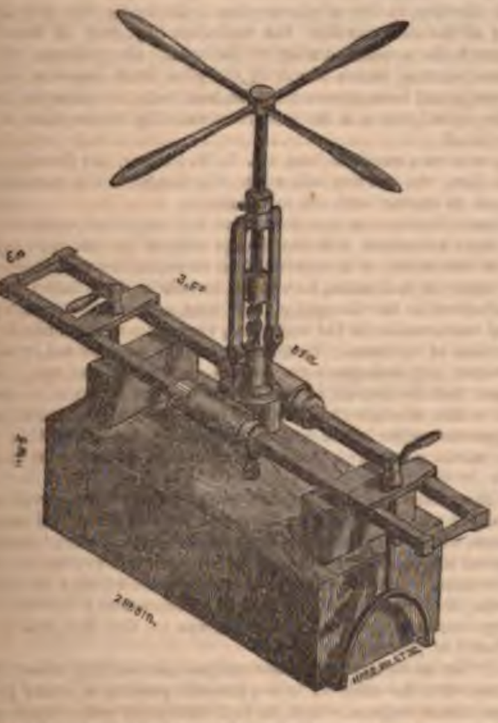
Mr. Marshall desired it to be borne in mind that the cut stone front of the mill had greatly enhanced the cost, and that being the first building of the kind erected in the neighbourhood of Leeds, it had naturally been more expensive than others would be.

"*Account of the Explosion of a Steam Boiler at the Penydarran Iron Works, South Wales.*" By Adrian Stephens.

The boiler, the explosion of which is described in the paper, was one of a pair for furnishing steam to a high-pressure engine, with a cylinder of 26 inches diameter, working expansively, the steam being cut off at half the stroke; each of these boilers was 41 feet long, and 7 feet diameter, with a centre tube flue of 4 feet 2 inches diameter; the thickness of the plates throughout was ½ inch; the ends were flat, with rings of angle-iron, and the pressure of the steam to which the safety valves were weighted was 50lb. on the square inch. From appearances after the explosion, it was conjectured that the tube, which was collapsed in a remarkable manner in its entire length, had been softened by the heat, having probably been left dry along the upper side. No opinion is given as to the cause of the explosion, but it is particularly mentioned that the supply of feed-water depended upon the regular attention of the engineer, and that the feed-pipe was placed so that the water fell directly upon the hottest part of the tube flue, and it is remarkable that the tube is most extensively fractured at that spot. All the appearances presented by the boiler both before and after the explosion and the injury done by the event are accurately detailed, and the paper was illustrated by a drawing of the boiler and the setting.

STONE BORING MACHINE.

Mr. Carnegie presented one of Hunter's Stone Boring Machines to the Institution, and explained its action to the meeting.



The machine is composed of two parallel bars of steel, supporting a traversing carriage, through the centre of which passes a spiral auger attached to a screwed bar; this bar fits into a female screw clamp above the carriage, and on the upper end is a winch with four handles. When the instrument is in use it is fixed by two cramps upon the stone to be pierced, and the auger being made to revolve by means of the winch, scoops out at each revolution as great a depth of stone as is equal to the distance which the screw descends; the chips ascending through the spiral channel of the auger, are thrown off at the top. The peculiar shape of the point of the auger prevents its being abraded, as it operates by chipping the stone, and not by grinding it away. This, with the means of forcing it down by the screw, is the chief novelty of the machine. It has been extensively used at the works of the new Harbour of Arbroath, by Mr. Leslie, who speaks of it in the following terms:—

"Mr. Hunter's Boring Machine has been advantageously employed for above a year, in boring trenail holes in the stones used at the new Harbour of Arbroath. The holes are 1¾ inch diameter, and from 9 inches to 2 feet in depth: the aggregate of the holes already bored amounts to upwards of 30,000 linear feet. The machine may be adopted for boring holes of any dimensions. It does the work considerably cheaper than the "jumper," and much more correctly, as it makes the holes perfectly straight, cylindrical, and equal throughout, instead of the irregular form made by the common jumper. This machine is very well adapted for boring railway blocks, and has been much used in this quarter for that purpose. I consider it to be more especially valuable from the facility which it affords of boring and trenailing down the stones used in sea buildings in any exposed situation, as I have found that trenailing is a great security to such building while in progress, when the upper courses are much exposed and liable to be washed off unless they be held down by other means than their own absolute weight. The expense of boring the old red sandstone rock, here, is about three halfpence per linear foot.

Remarks.—Mr. Vignoles bore testimony to the advantages of the machine: he was now employing it for piercing holes in stones going from Arbroath to the West Indies for the construction of a patent slip—there was great economy of cost and time by its use in addition to the superior manner in which the holes were made.

Mr. Smith, of Deanston, was convinced of the advantage of the machine in working almost all kinds of stone, but more especially for those resembling the Arbroath stones, which were from a bed beneath the old red sandstone: they were of fine grit mingled with schistose debris. The action of the tool was like that of the stone-planing machine, to burst chips off instead of grinding down the surface by small portions and destroying the edge of the tool at the same time. With the planing machine it was common to take off a thickness of 3 inches at one passage of the tool—it acted like a "pick;" and being fixed in a frame weighing about 1½ ton, the power was great; at the same time there was little abrasion of the tool and it never became heated or softened. It was probable that with other qualities of stone a screw with another pitch of thread might be required to force the auger forward, but with the thread now used in boring stones from the Arbroath quarries, the economy of time and cost appeared very great. In each of the blocks for the Arbroath railway it was requisite to bore two trenail holes 1½ inch diameter and 6 inches deep—and to level a space 9 inches diameter to receive the cast-iron chair: this had been contracted for at twopence halfpenny per block, which was a material diminution of the usual cost. He was convinced that the instrument only required to be known to be extensively used.

Mr. F. Braithwaite had for some years used Hunter's stone-planing machines, for dressing up slate and other stones, and was well qualified to give a favourable opinion of the principle of its action: he believed that the machine under discussion being upon the same principle must be very useful.

May 24.—The PRESIDENT in the Chair.

"*On the machinery used for working the Diving Bell at Kingstown Harbour, Dublin.*" By Peter Henderson, Assoc. Inst. C. E.

After referring for the details of the machinery to the two drawings which accompany the paper, the author describes the foundations of the pier head to have been laid in a depth of 20 feet at low water on rock and firm sand. For 14 feet from the bottom, the wall is formed of Runcorn sandstone of fine quality, each stone containing about 50 cubic feet and thoroughly squared. This has been preferred to granite on account of its cheapness and the facility with which it is worked under water. After the foundation course is secured, from 300 to 350 cubic feet of this walling are frequently set in a perfect manner by the diving-bell during a fair working day of eight hours. The first stone was set on the 5th of August, and by the 1st of January 16,000 cubic feet had been laid. From 6 feet below low water to the coping, it is proposed to make use of granite in blocks of 50 cubic feet each, which is procured cheaply and in abundance in the immediate neighbourhood. The piers are finished in the interior by walling of rubble stone carefully laid. For the purpose of forming this excellent harbour, an area of 251 acres has been inclosed between two substantial stone piers of 8,340 feet in length, affording clear anchorage in a depth of water from 15 to 27 feet at low spring tides. The interior shows no natural tendency to collect deposits likely to reduce the depth of water, nor do any of the works exhibit symptoms of deterioration, while its continual occupation by vessels of every description, together with the comparative freedom from accident in Dublin Bay, afford convincing proof of its great utility.

"*Description of a Steam Dredging Engine used upon the Caledonian Canal.*" By Walter Elliot.

The machine described in this communication is not remarkable as being of the most perfect description, but as it is stated to be among the earlies which were brought into use in this country, a certain degree of inte attached to it. It was constructed in the year 1814 expressly for mation of the Caledonian Canal, and it was also used for deepening the channels through the shoals in Loch Dochfour and Loch Ness. The length of the vessel is 80 feet by 23 feet in width; the bucket frame is 42 feet long, with 25 buckets, worked by a condensing steam engine of 6 H. P. The dimensions of all the principal parts of the machinery are given minutely, with accounts of several experiments for extending the use of the dredger. On one occasion, as it was found that the buckets had much difficulty in penetrating the hard mountain clay, every alternate bucket was removed and a pair of steel cutters substituted for each, in the expectation that the clay would be loosened and the succeeding bucket would take it up more easily. They did not, however, act satisfactorily, and a risk of fracture was incurred which induced the abandonment of the plan. On another occasion, in forming a portion of the canal between Loch Ness, and the lochs at Fort Augustus, where the height of the ground above the water averaged from 20 to 30 feet, and the excavation was required to be about 16 feet beneath it; that part of the cutting above the water level was commenced by manual labour, while the dredging machine did the excavation under water; it was soon found, however, that the engine having completed its share of the task, continued to undermine the upper portion, which, being of a loose nature, fell into the water, and was raised by the buckets so rapidly that the manual labour could not compete with the machine, and it was then used to complete the undertaking, which it did in eight months, having in that time excavated about 170,000 cubic yards of material. When working in favourable situations the quantity generally raised equals 90 tons per hour; 17 of the buckets are discharged per minute, with an expenditure of coal of about 15 cwt. per day The communication was illustrated by two detailed drawings of the boat and its machinery.

"*Description of the Maplin Sand Lighthouse at the mouth of the River Thames.*" By John Baldry Redman, Grad. Inst. C. E.

The paper commences with an enumeration of the various channels and sandbanks at the mouth of the Thames, with the floating lights, beacons, and buoys marking the entrances of the Channel, and gives the objections to floating lights, and the reasons for selecting the Maplin Sand as the position for a fixed lighthouse.

In the year 1837 a survey was made by Mr. Walker, the engineer to the Trinity House, and by boring it was ascertained that the first six feet of the sand was close and compact, but below that for 20 feet the boring rod went more easily as it descended, and it was found that it became mingled with argillaceous earth as the depth increased.

It was then decided to use for the foundations Mr. Mitchell's screw moorings, and in 1838 the patentee, under Mr. Walker's directions, commenced fixing nine cast-iron screws of 4 feet diameter so as to form an octagon with one screw in the centre; attached to each of these screws was a cast iron pile 5 inches in diameter and 26 feet long, which was inserted into the sand 21 feet below low-water mark. On account of the constant shifting of the sand from around the piles it was determined to place a raft or grating of timber around and between them; the surface of the raft was covered with faggots of brushwood well fastened to the timbers, and upon them was deposited 120 tons of rough Kentish ragstone, by which the raft was secured in its situation, and after a time no farther changes occurred in the level of the surface of the sand. In the summer of 1840 the superstructure was commenced; it consisted of nine hollow iron columns or pipes curved at the top to a radius of 21 feet towards the centre; they were secured upon the piles, and two series of continuous circular horizontal ties bound them together, while they were connected with the centre column by diagonal braces—all of wrought iron. Upon these columns is built a wooden dwelling for the light-keepers, in the upper part of which is placed a French dioptric light of the second order, its centre being 45 feet above the mean level of the sea, and at that elevation can be seen from a ship's deck at a distance of nine or ten miles; a bell is fixed on the gallery which is sounded by machinery at intervals during dark and foggy nights.

The communication gives all the details of the dimensions and the mode of fixing the cast iron screws and piles made by Messrs. Rennie's—the iron work by Messrs. Gordon's of Deptford—the wood work by Messrs. Gates and Horne of Poplar, and the lanthorn by Messrs. Wilkins—and the whole is illustrated by a series of drawings which fully describe this useful construction, which has hitherto withstood the most violent attacks of the sea to which it is exposed.

Remarks.—In answer to questions from the President, Mr. Wilkins stated that he had been in the Eddystone and the Maplin Sand lighthouses during severe gales of wind; that as might be conceived from the nature of the construction, the latter building was more affected than the former by the striking of heavy seas; the motion appeared to be more like torsion than simple vibration, which he attributed to the waves striking the ladder and its projecting stage, and thus tending to twist the upper part. Still the motion was not such as would cause injury to the building.

The President pointed out two diagonal braces extending downward from the end of the ladder stage to the piles on either side, which had been introduced in order to counteract the twisting described by Mr. Wilkins. In constructions of this nature it was of importance to oppose as little resistance as possible to the seas, especially in the upper part of the building, a system of bracing had therefore been adopted, which consisted principally of two series of continuous circular horizontal ties between the piles at the several heights of 6 feet and 15 feet above low-water mark of spring tides. From the external ring of piles two sets of diagonal stays extended to the centre pillar, forming strong triangular trusses in the direction of each pile, and two sets of horizontal stays stretched between the piles and the centre pillar at the levels of the circular bands. The amount of direct vibration was very small, and he did not conceive that the twisting motion which had been described was sufficient to warrant the introduction of diagonal braces, which would materially augment the surface upon which the waves would act.

Mr. Vignoles directed the attention of the meeting to the system of diagonal bracing between the piles which had been adopted at the Port Fleetwood lighthouse; he apprehended that as the principal force of the waves would be exerted against that part of the structure which was above the high-water level, the diagonal braces extending between the upper part of the piles and the level of low-water were preferable to the horizontal continuous bands of the Maplin Sand lighthouse, although assisted by the system of radiating central truss braces which it possessed: he conceived that both buildings were strong enough for the purposes for which they were constructed, but he preferred the mode of bracing adopted in the Port Fleetwood house, the vibration of which he knew to be very small, although situated in an exposed position where the rise of the tide is 30 feet.

Mr. Donkin observed that there could not exist a doubt of the introduction of diagonal braces rendering the building stronger; how far they were necessary, or might be prejudicial in offering additional resistance to the passage of the waves, should be well examined before adopting them. He considered the position of the suspended ladder decidedly objectionable, as any torsion caused by the waves striking it must tend to dislocate the fibre of the material of the piles and to fracture them.

Mr. Farey believed the construction of the Maplin Sand house to be better adapted than the Fleetwood house for resisting the direct action of waves, but the diagonal bracing of the latter enabled it to withstand torsion better than the hoop bracing of the former. He inquired why the lower part of the light-keeper's house was made conical, as he apprehended that it would receive a heavier blow from a wave than if it had been flat.

The President replied that the main body of the waves seldom or never rose so high as the bottom of the house, and that the conical form allowed the air and spray to rise up and be guided off without affecting the building as it would do if the bottom was flat. With regard to the torsion, that had only been felt at first, when the ladder extended too low down and received a constant succession of blows from every wave, which naturally communicated a vibration to the whole structure; the ladder was now shortened, and nothing of the kind was felt: the waves scarcely, even in the roughest weather, struck the suspension stage or the boat. He preferred the continuous horizontal bracing, which bound all the piles firmly together like the staves of a barrel; and from observations he had made, he believed the amount of vibration to be greater in the Port Fleetwood lighthouse than in that at the Maplin Sand.

In answer to a question from Mr. G. H. Palmer, the President said that at present there was not any indication of a change in the condition of the cast iron from its contact with the salt water.

Professor Brande was unable to give any additional evidence on the observed facts connected with the change suffered by cast iron exposed to the action of salt water, or in mines and in various other positions—from experiments which he had made, he was led to believe that many of the appearances observed in the changes of cast iron arose rather from a peculiar mechanical combination of the molecules, than from a difference in the chemical constitution of the metal; no difference could be detected by analysis in the metal which had undergone change and that which had not. It should be remarked that the contact of two metals was not essential to cause galvanic action; a film of oxide upon the surface of the body of metal formed a very active galvanic pile: hence arose the necessity for preventing oxidation by proper paints or varnish before using pieces of cast iron in exposed situations.

Mr. Farey observed that in the early engines constructed by Woolf in Cornwall, in which the packing segments were of gun-metal and the body of the piston was of cast iron, wherever the two metals were in contact the iron was turned to plumbago; this had been particularly observed where high-pressure steam was used: it might be a question whether the temperature of the steam, and the quantity of mineral water carried over with the steam by the large amount of priming of the engines in that day, had not materially contributed to produce the effect.

Mr. P. Taylor believed that the temperature of the steam had not any connexion with the subject; in the metallic packing of steam pistons of low-pressure marine engines, which he had constantly under repair at Marseilles, wherever the wedge pieces were of gun metal, the backs of the cast iron segments were converted into plumbago, while those surfaces of cast iron which were ground together and worked against each other remained unchanged; the same might be said of the rubbing surfaces of cast iron against gun-metal; it appeared, therefore, that the formation of an oxide was necessary to commence the change. He repudiated the use of cast iron in situations where these changes were to be apprehended; he would employ wrought iron, as although that did become oxidized, it retained its relative strength to the last, whereas cast iron, when changed into plumbago, retained its bulk but lost nearly all power of cohesion.

Mr. John Taylor said that in Cornwall the cast iron pump-trees exposed to the action of mine water were very speedily destroyed; and even although 1½ inch thick, they could be cut to pieces with a knife when first taken out of the pit. The air-pump buckets of steam engines, in which the body was of cast iron and the valves of gun-metal, formed the most perfect kind of galvanic apparatus; they should be made entirely of gun-metal. In manufactories of vinegar and pyroligneous acid the decay of cast iron was very rapid.

Mr. Glynn attributed in a great degree the rapid decay of cast iron in coal mines to the presence of sulphuric acid evolved from the pyrites. Mr. Philip Taylor agreed with Mr. Glynn; even copper pipes were rapidly destroyed in the bilge water of vessels, which always contained much sulphuretted hydrogen—he recommended the use of stout lead pipes in such situations; they would be found much more durable.

Mr. Davidson had found it necessary to substitute gun-metal gratings for the cast iron ones at Messrs. Hanbury's brewery, as although they were ¾ in. thick, they had been entirely destroyed in four years.

The President gave a short account of the construction of a light-house now making by Messrs. Gordon & Co. at Deptford under his directions for the Point of Air. The lanthorn for it would be cast from a gun which had been raised from the wreck of the Royal George.

Sight-tube for Marine Boilers.

Mr. C. W. Williams exhibited and explained the sight-tubes which he now used for the marine boilers of the City of Dublin Steam Packet Company's vessels.

The instrument consists of a wrought iron welded tube 2 inches diameter with a screw thread cut upon the exterior; it is inserted across the water spaces of the boilers, and secured by means of nuts in such positions behind and opposite the furnace, as enables the engineer to see all that goes on interiorily, particularly the degree of perfection or imperfection in which the gaseous matter enters into combustion, and the effect of admitting or excluding the air.

The instrument had been found very useful, not only in experiments, but in practice on the large scale, and he deposited it in the Gallery of the Institution in order that it might serve as a model for those who were inclined to adopt it in marine boilers.

THE VARIATION OF THE COMPASS.

Observations made at the Royal Observatory, Greenwich,
G. B. Airy, Astronomer Royal.

Mean Magnetic	Variation.	Dip at 9 A.M.	Dip at 3 P.M.
	° ′ ″		
1842. June	23 14 5		

During the month of June, 1842, the dipping needle was out of repair.

REPORT OF THE COMMISSIONERS ON THE FINE ARTS.

(Continued from page 308.)

VARIOUS COMMUNICATIONS ON FRESCO PAINTING.

The following papers contain further information respecting the practice of fresco-painting, or point out the sources where the subject is more fully treated. In inserting these communications and extracts, it has not been possible to avoid occasional repetition, but in some cases coincident testimony may be necessary to establish or recommend particular methods. While the question respecting the adoption of fresco remains, for the reasons before stated, undecided, it may appear premature to describe its methods so fully, but it is precisely because so little is generally known of the process, in this country, that it has been thought desirable to take this means of putting the artists and the public in possession of the information that has been collected.

A communication on fresco by Professor Hess, of Munich, (to Mr. William Thomas) need not be given at length, as it agrees generally with the foregoing statements by Director Cornelius. In speaking of the preparation of the wall Professor Hess recommends "bricks well dried, and of equal hardness" as the groundwork of the mortar and plaster. Mr. Thomas observes, "all the frescos in Munich are painted on the (plastered) brick wall: laths with wattling and copper nails are not approved of, as the risk of bulging is thus increased. The use of laths is sometimes necessary for certain surfaces, but the professors in Munich are decided that a brick ground is to be preferred wherever it is practicable, not only on account of its solidity, but also because it is better adapted for the execution of the painting. The brick ground absorbs superfluous water and keeps the plaster longer in a fit state for painting upon. The painting ground dries much quicker on laths as two surfaces are presented for evaporation. The walls ought to be thoroughly dry. A wall of a brick, or a brick and a half, in thickness, is preferable to paint upon. Professor Hess once observed to me that where the walls in the lower portions of buildings were five or six feet thick, the liability of saline matter making its appearance was much increased, as the mass of wall remains longer in a humid state."

Mr. C. H. Wilson, professor of ornamental design in the Royal Edinburgh Institution, has contributed much useful information on the subject of fresco, derived from his own observation in Italy, and from recent communications from his father, Mr. Andrew Wilson, now at Genoa. He observes: "In Italy the practice of lathing *walls* is unknown, but many of the finest Italian *ceiling* frescos are on lath, and are in perfect condition. Most vaulted ceilings in what is termed the *piano nobile*, or principal floor of every palace, are constructed of wood. The lathing in this case is not attached to single thin pieces of timber, cut to the shape of the ceiling, but to a strong grating; in some cases the ribs and transverse pieces of this grating are four inches thick each way. The lathing in Italy is a very peculiar process. The material is the reed, which is cultivated so extensively in that country, and used in so many ways. It grows to the length of about 18 feet, and is rather more than one inch and a quarter diameter at the base. When these reeds are used for lathing they are split, and not being strong enough for the purpose in this state, they are wattled upon the grating. The result of this somewhat complicated contrivance is a framework of great strength."

Mr. Hamilton, a distinguished architect of Edinburgh, observes: "In the preparation of walls and ceilings for fresco-painting, no expense should be spared; battens and lath are obviously perishable materials, and therefore ought to be avoided. The damp from exterior stone walls may be guarded against by lining them with brick, and now that the use of cast-iron is so well understood, the girders or joisting of houses where fresco-painting is contemplated should be of iron arched with brick between, and thus a perfectly level ceiling may be formed of the most durable kind." For the more effectual prevention of damp, Mr. Hamilton recommends that the lining of brick should be somewhat detached, leaving a small space between it, and the stone wall, to which it could be bound at intervals. Mr. C. Wilson in communicating this opinion, remarks, that as the brick lining, added to walls of sufficient solidity for the support of the ceiling here described, would diminish the size of the rooms, tiles placed edgewise might be used instead of bricks. These should, however, be of sufficient strength to be in no danger of fracture from any ordinary accident. To guard against damp from roofs or even occasional washing of upper floors, it is also suggested that a coating of asphalte might be applied on the upper sides of the arches of the ceiling. In some cases asphalte might be necessary in walls: Mr. C. Wilson observes, that a French architect, M. Polonceau, effectually checked the progress of damp from a humid soil in several instances, by covering the horizontal surface of the masonry a few inches above the level of the soil with a coating of liquid asphalte, applied with a brush; when this was dry it was covered with a layer of coarse dry sand, and the building then proceeded. An external joint of hard asphalte at the same level is necessary effectually to cut off all communication of damp. (See the "Revue Générale de l'Architecture, September, 1841). These and other remarks on the construction of walls and ceilings have been communicated with all deference to the judgment and experience of the architect of the new buildings at Westminster.

In considering the question respecting the comparative fitness of laths and bricks, as a groundwork for fresco, it is not to be forgotten that the battened wall sooner adaps itself to the temperature of the atmosphere, and is therefore less likely to be affected by external damp; while the coldness of the more solid wall causes the rapid condensation of moisture in humid weather. This evil might perhaps be guarded against by due precautions with regard to temperature and ventilation.

Mr. C. Wilson next describes the mode of preparing the lime at Genoa:—"The lime having been slaked is mixed in a trough about six feet in length, and 20 inches in width; at the bottom it is somewhat narrower. The instrument used in mixing it is similar to that used by our masons. The lime is worked with this, and water is thrown in till the substance is of the consistence of cream. At the end of the trough there is a little sluice, the opening of which however comes only to within an inch and half of the bottom of the trough. On being drawn up, the sluice allows the lime to escape, but small stones or impurities which may have sunk to the bottom are prevented from passing by the ledge under the opening. The lime is received in a pit dug in the mere earth (not lined) to the depth of several feet, and of any convenient size. The process of mixing in the trough is repeated till the pit is well filled, the trough being washed out with clean water every third or fourth mixing."

"The lime being thus prepared is left in the pit from *eight to twelve months** according to its ascertained strength. The lime for the first rough coat need not be kept more than two months: this is allowed to dry perfectly, before the next coats are put on. The proportion of sand to lime is the same as with us, viz. two of sand and one of lime. No hair is used by the Italian plasterers. The lime of which the *intonaco* or coat of fine plaster is composed, is however to be subjected to a much more careful preparation than that used for the first coat. After it has been kept the requisite time, it is taken out with a spade, the greatest care being necessary not to come too near the edges, sides, or bottom of the pit, lest any clay or earth should be taken up with the lime. It is now thrown again into the trough [illegible] again thoroughly mixed with water, till it is not thicker [illegible] allowed to escape us before through the ope[illegible] through a fine hair sieve into an earthenware jar; a number of these jars are required, and each is filled to within a third of the top. The lime is allowed to settle, and when the water which rises over its surface is clear, it is poured off. This is repeated till there is no mhre water to pour off, and the lime remains in the jar of the consistence of the white paint commonly used, and is quite as smooth. It is now ready to be mixed for the *intonaco*, which consists as usual of two parts sand and one of lime. Great pains are taken in Italy to find a suitable sand: it must be perfectly clean, sharp sand, the grains of equal size, and its colour favourable, as the *intonaco* should not be too dark. The presence of any earthy particles in the plaster would inevitably ruin the fresco: this accounts for the very careful preparation which all the materials used undergo."

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* In Florence, where fresco-[illegible] are of opinion that, "the lim[illegible] *to twelve months*, otherwise it [illegible]

Professor Hess recommends avoiding the intermixture of plaster of Paris in the mortar for the first rough coat (in the finer coats it is never employed as a preparation for fresco) and advises o moderute use of small flint pebbles. The rough coat should not be too compactly laid on, as its porousness is essential to the convenience of fresco painting. In like manner the last finer coats should be lightly floated on to ensure their power of absorption. He proceeds: "The plaster for painting on is composed of lime not in too caustic a state and pure quartz sand. With regard to the lime it should be well and uniformly manipulated, and should be entirely free from any small hard lumps. The sand should be very carefully washed to cleanse it from clayey or saline particles, and should be afterwards dried in the open air. Sand that is course or unequal in grain should be sifted; thus the plaster will be uniform in its texture. The proportion of sand to the lime is best learned from experience, and must depend on the nature of the lime. If the plaster contains too much lime it becomes incrusted too soon, is too smooth in surface and easily cracks; if it contains too little it is not easily floated, the successive patches (as the fresco proceeds) are not to be spread conveniently in difficult situations, and the plaster is not so lasting.

"Before laying on the plaster, the dry rough coat is wetted with a large brush again and again, till it will absorb no more. Particular circumstances, such as spongy bricks in the wall, humid or very dry weather &c. dictate the modes in which this operation is to be regulated. The plaster should be laid on lightly and freely with a wooden hand-float; in connecting the successive patches some portions require however to be finished with an iron trowel; in this case care must be taken not to press too strongly, otherwise rust spots might appear in the lime, and even cause portions of the superadded painting to become detached. [A glass float seems to be preferable where a wooden instrument is unfit.] The plaster should be about a quarter of an inch in thickness. The surface of the last coat is then slightly roughened to render it fitter for painting on. The wall thus prepared is to be left a quarter or half an hour before beginning to paint."

The colours enumerated by Professor Hess are the following. "White: lime which has either been long kept, or by repeated manipulations and drying is rendered less caustic. Yellow: all kinds of ochres, terra di Sienna, Red, all kinds of burnt ochres, burnt terra di Sienna, [the brightest particles selected at different stages of the process of burning, furnish, according to Director Cornelius, very brilliant reds,] oxides of iron, and lake-coloured burnt vitriol. Brown: umber, raw and burnt, and burnt terra vert. Black: burnt Cologne earth, which when thus freed from its vegetable ingredients, affords a pure black. Purple: burnt vitriol, cobalt blue, and lake-coloured burnt vitriol. Green: Verona green (terra vert), cobalt green, and chrome green. Blue: ultramarine, cobalt, and the imitation of ultra-marine; the last is most safely used for flat tints, but does not always mix well with other colours. These colours have been well tested, and for the most part admit of being mixed in any way. Other more brilliant colours, such as chrome yellow. vermillion, &c., have been tried in various ways, but have not yet in every case, been found to stand. Colours prepared from animal and vegetable substances cannot be used at all as the lime destroys them." Fresco-painters observe that "great attention is necessary in the due preparation of tints on the palette, for if tints are mixed as the work proceeds, the painting when dry will appear streaky: when the colours are wet the differences are not so perceptible."

In additions to hog's hair tools, which, as before observed, are longer than those used in oil painting, "small pencils of otter hair in quills are used. No other hair resists the lime, but becomes either burnt or curled. The palette of the material and form before described, is covered with a light coloured varnish to protect the tin from rust. Rain water (that has not passed through an iron tube,) boiled or distilled water should be used from first to last in all the operations of fresco-painting."

Professor Hess continues:—"After the painter has laid in his general colour, he should wait half an hour or an hour, accordingly as the colour sets, before he proceeds to more delicate modelling. In these first operations he should avoid warm or powerful tints, as these can be added with better effect as the work advances. After the second painting and another shorter pause, the work is finished with thin glazings and washings. In this mode the requisite degree of completion can be attained, provided the daylight and the absorbing power of the plaster last. But if the touches of the pencil remain wet on the surface, and are no longer sucked in instantaneously, the painter must cease to work, for henceforth the colour no longer unites with the plaster, but when dry will exhibit chalky spots. As this moment of time approaches, the absorbing power increases, the wet brush is sucked dry by mere contact with the wall, and the operation of painting becomes more difficult. It is therefore advisable to cease as soon as these indications appear.

"If the wall begins to show these symptoms too soon, for example in the second painting, some time may be gained by moistening the surface with a large brush, and trying to remove the crust or setting that has already begun to take place: but this remedy affords but a short respite. In the additions to the painting on successive days, it is desirable to add the new plaster to that part of the work which is not quite dry, for if added to dry portions the edges sometimes exhibit spots. Various other effects sometimes take place from causes that cannot be foreseen, and the remedies must be provided by the ingenuity of the artist, as the case may require."

The following extract from a letter addressed by Mr. Andrew Wilson to his son (in March last) will render the process of painting in fresco more intelligible; but it is almost needless to observe, that in such details, the practiee of painters may vary considerably.

"I lately went to the royal palace (Genoa) to see the Signor Pasciano paint a ceiling in fresco. His tints had all been prepared before my arrival; he had only two in pots, viz. pure lime and a very pale flesh tint. He had no palette, but a table with a large slate for the top: on it he set round, 1. Terra vert. 2. Smalt. 3. Vermilion. 4. Yellow ochre. 5. Roman ochre. 6. Darker ochre. 7. Venetian red. 8. Umber. 9. Burnt umber. 10. Black. These colours were all pure, mixed only with water and rather stiff put down with a palette knife, perhaps about an ounce, or two at most, of each. He mixed each tint as he wanted it, adding to each from the pot of flesh tint or that of white. Near him lay a lump of umber, and on taking up a brushful of colour he touched this with it; the earth instantly absorbed the water, and he was thus enabled to judge of the appearance which the tint would present when dry. The painter used a resting stick with cotton on the top to prevent injury to the *intonaco*. The *intonaco* being prepared in the manner which I have described, the moment it would bear touching, he set to work. The head was that of the Virgin; he began with a pale tint of yellow round the head for the glory, (the colour of the ground, owing to the mixture of sand with the lime, it is to be remembered is a cool middle tint,) he then laid in the head and neck with a pale flesh colour, and the masses of drapery round the head and shoulders with a middle tint, and with brown and black in the shadows. He next, with terra vert and white, threw in the cool tints of the face; then with a pale tint of umber and white modelled in the features, covered with the same tint where the hair was to be seen, and with it also indicated the folds of the white veil. All this time he used the colours as thin as we do in water colours; he touched the *intonaco* with great tenderness, and allowed ten minutes to elapse before touching the same spot a second time. He now brought his coloured study, which stood on an easel, near him, and began to model the features, and to throw in the shades with greater accuracy. He put colour in the cheeks and put in the mouth slightly, then shaded the hair and drapery, deepening always with the *same* colours, which become darker and darker every time they are applied, as would be the csse on paper for instance. Having worked for half an hour, he made a halt for ten minutes, during which time he occupied himself in mixing darker tints, and then began finishing, loading the lights and using the colours much stiffer, and putting down his touches with precision and firmness: he softened with a brush with a little water in it. Another rest of ten minutes: but by this time he had nearly finished the head and shoulders of his figure, which being uniformly wet, looked exactly like a picture in oil, and the colours seemed blended with equal facility. Referring again to his oil study, he put in some few light touches in the hair, again heightened generally in the lights, touched too into the darks, threw a little white into the yellow round the head, and this portion of his composition was finished, all in about an hour and a half. This was rapid work, but you will observe that the artist rested *four times* so as to allow the wet to be sufficiently absorbed into the wall to allow him to repass over his work.

"The artist now required an addition to the *intonaco;* the tracing was again lifted up to the ceiling, and the space to be covered being marked by the painter, the process was repeated, and the body and arms of the Madonna were finished before I left him at one o'clock."

The following is an extract from a second letter. "Yesterday I went again to see Pasciano, and I found that he had cut away from his tracing or cartoon those parts which he had finished upon the ceiling: in fact I now found it cut into several portions, but always carefully divided by the outline of figures, clouds or other objects. These pieces were in some instances a good deal detached from each other, and were nailed to the plaster so as to fold inwards or outwards for pouncing the outlines. The *intonaco* had just been fresh laid for the upper half of an angel supporting the feet of the Madonna: this was one of a group much larger than those surrounding the glory, and therefore requiring more colour and finish; more than half of the figure too was in shadow, with a strong ray of light on the face and on one of the arms: this was a good opportunity of observing the painter's management of shadow. Having gone over the outline carefully with a steel point, he waited till the *intonaco* became a little harder, and in the mean time mixed up a few tints, he then commenced with a large brush and went over the whole of the flesh: he next worked with a tint which served for the general mass of shadow, for the hair, and a slight marking out of the features. He now put a little colour into the cheeks, mouth, nose and hands, and all this time he touched as lightly as he possibly could, not to wash up the *intonaco*. He then halted for ten minutes, looking at his oil study, and watching the absorbtion of the moisture, and he called my attention to his outline: none of it was effaced by this washing.

"The *intonaco* would now bear the gentle pressure of his fingers, and with the same large brush, but with water only, he began to soften and unite the colours already laid on. Observe, he had not as yet used any tint thicker than a wash of water colour, and he continued to darken in the shadows without increasing the force or depth of colour. This I before noted to you, that you can strengthen by the simple repetition of tint, but if the day be very dry, after an hour or two this process of repeating with the same tint produces an opposite effect, and instead of drying darker, it actually dries lighter. [See this explanation in the communication by Professor Hess.] I now observed that the painter had increased the number of his tints, and that they were of a much thicker consistence, and he now began to paint in the lights with a greater body of colour, softening them into the shades with a dry brush, or with one a little wet as he required. In drying, the water comes to the surface, and actually falls off in drops, but this does no harm whatever to the work although it sometimes looks alarming."

Mr. C. Wilson observes that the Aurora of Guido in the Rospigliosi palace in Rome was painted on a copper trellis, and afterwards fixed on the ceiling where it still exists. He adds that this fresco was offered for sale about fifteen years since, and that its safe removal was guaranteed. Mr. W. Thomas states that some small (landscape) frescos by Professor Rottman, in the Hofgarten in Munich, were painted on an iron frame and wire-work, and fixed in their situation afterwards. The example of Guido's Aurora, the figures of which are larger than life, shows that it would be possible to prepare movable frescos for situations where this might be thought necessary; for example, before flues or tubes in walls. But it is to be remarked that flues behind frescos have generally injured them. Mr. Aglio, who painted some frescos at Manchester some years since, attributes the great alteration of the colours in them partly to this circumstonce; but also to his having been supplied with lime that was much too fresh. Cavaliere Agricola, in examining the frescos of the Vatican, found that the "Heliodorus" had suffered considerably from a flue behind it. The plaster had been detached from the wall, and projected in some places nearly four inches: it had been secured with nails, and the cracks had been filled with some composition by Carlo Marotti in 1702. The fresco of the "Defeat of the Saracens at Ostia" has been injured in like manner by a chimney behind it.

Detaching frescos from the wall—In connexion with the subject of moveable frescos it may be observed that the operation of detaching the mere painting from the wall, almost independently of the plaster, has been often practised with success. Although less immediately connected with the present inquiry, it is desirable to make this process known, as, in repairing churches and other buildings in England, many ancient paintings on plaster have been destroyed, from ignorance as to the means of removing them. Mr. Ludwig Gruner gives the following account of the mode in which he detached some frescos at Brescia in 1829. The convent of St. Eufemia in that city was then undergoing repair, and the excellent frescos it contained, painted by Lattanzio Gambara in the 16th century, would have been destroyed, when Mr. Gruner succeeded, with the assistance of some expert Italians, in removing them from the walls. The mode they adopted was first to clean the wall perfectly: then to pass a strong glue over the surface, and by this means to fasten a sheet of fine calico on it. The calico, after having been rivited to the irregularities of the wall, was afterwards covered with glue in like manner, and on it was fastened common strong linen. In this state heat was applied, which caused the glue even on the fresco to sweat through the clothes, and to incorporate the whole. After this a third layer of strong cloth was applied on a new coat of glue. The whole remained in this state two or three days, (the time required may vary according to the heat of the weather). The superflous cloth extending beyond the painting was now cut off so as to leave a sharp edge: the operation of stripping or rolling off the cloth began at the corners above and below, till at last the mere weight of the cloth and what adhered to it assisted to detach the whole, and the wall behind appeared white, while every particle of colour remained attached to the cloth. This operation shows that the colours in fresco do not penetrate very deeply: the layer of pigment and lime which was detached in this instance was extremely thin, the outlines and even the colours of masses were visible at the back of the cloth. It is the opinion of some of the Munich professors that frescos thinly painted are least liable to change; the example just given, exemplifying as it does the practice of a skilful Italian fresco painter, seems to confirm this, but in many instances the surface of frescos even by the older masters is solidly painted. To transfer the painting again to cloth, in completing the operation above described, a stronger glue is used which resists moisture, it being necessary to detach the cloths first used, by tepid water, after the back of the painting is fastened to its new bed.

The frescos by Paul Veronese, in the Morosini Villa, near Castel Franco, were removed by Count Balbi of Venice, a few years since: he fastened cloth to the wall with a paste composed of beer and flour, and rivetted it to the irregularities of the surface by means of a hammer composed of bristles. Several of these works when re-transferred to canvass were sold in England in 1838. The operation of removing frescos has been lately performed with success in Florence and elsewhere.*

LAST DAY OF WILKIE'S EXHIBITION AT THE BRITISH GALLERY.

Sɪʀ—Do you admit gossip as a relief to Science? if so, the following reminiscences may amuse your readers.

B. R. H.

An exhibition of the best works of a great artist after he is dead, at our British Gallery, is the last tolling of his funeral bell;—the last effort of those who respected his character, and wish to put the seal upon his fame—before leaving both to the unbiassed and sifting decision of a future generation. How must the artist and the public have been indebted to the British Gallery!—how much the public taste has been solidly advanced by its various exhibitions of fine works!—what good has been done—what knowledge has been indirectly inculcated; how greatly the standard of excellence in the country has been raised, since these May displays began: what a study it is to look forward to;—now we have the majestic cartoons, then the crimson splendour, and golden tones of Titian; now the pearly glitter of Veronese, then the startling dash of Tintoretto: at one time the gorgeous glory of Rubens, and mysterious depth of Rembrandt, at another the sunny loveliness of Claude, and savage poetry of Salvator; sometimes we are enchanted by Corregio, or instructed by Poussin; and then came the modern school; Reynolds who might fear comparison with none for grace, for character, for taste, for touch, for gemmy surface, in portrait, for the quivering sweetness of children, and who was equal to all and often superior to all, in the splendid depth and keeping of a back ground.

Gainsborough, with his sketchy richness, followed Hogarth with his blunt touch and bitter satire, and this year we have had David Wilkie, with his sound sense, his perspicuous conception, his beautiful composition, his natural expression, and his unaffected drawing; the founder of our domestic school.

In musing on the whole of Wilkie's works, from the earliest to the latest, there is the same sterling sagacity, and sense; the story, the expression, the composition, never vary in intelligence or power.

His incessant changes of practice, had something approaching to a feeble hallucination of intellectual power; why a man so consistent, and persevering, so unalterable and honest in one mode of conduct, morally which founded his domestic fortune, should be so vacillating and uncertain, so childish and changing, so furious in the morning at the discovery of the previous evening, and so disgusted the next day at what he thought such a philosopher's stone the day before, is not to be accounted for, but from some inherent imbecility.

The gem of this collection, without prejudice to others, is the card players, and here his practice was perfect—this is a work, in point of vigour, depth, daylight, tone, strength, touch, expression, finish, completeness, and life, no picture of the Dutch school, by Teniers, ever surpassed it in execution, whilst in point of story and sense, no picture by Teniers ever approached it.

I can tell the artist why this work is so extraordinary in power.

1st, It is the only picture he *prepared* for ultimate glazing.

Glazing softens and flattens, and if a picture to be glazed be not painted sharper in touch than nature, it will be flatter than nature when glazed.

2nd. He never lost sight of his ground in his deepest shadows, and finished his darks under the table and elsewhere by repeated thin glazings over each other—the ground always showing through.

Thus, in very early life, he hit on the system of Teniers, he hit on the principle of the Venetian, Flemish and Dutch schools, though scumbling is more applicable to the two latter, as an ultimate resource, and nothing could be so self-evident as the superiority of the picture or vigour, in spite of his greatest work, (the Duke's Chelsea Pensioners) and his Murray Group in Knox, one of the finest groups for everything in art the world can show.

In his early work, he ruined all color, by a heavy intermixture of a heavy and hot yellow tint in every portion of his work—with the single exception of a little picture he painted in Edinburgh, belonging to Dr. Darling, of the Village Politicians; at the repeated entreaty of the late Sir George Beaumont, of Jackson and myself, he tried flesh without it, and the right hand of the Blind-fiddler was his first attempt; yet it must be acknowledged he had no eye for colour, if he had had, he would have known when he had produced a fine tint, which he oft [illegible] ducing a fine tone, you are as likely to [illegible] Sir Joshua, because he was [illegible] ie's eye was never sat [illegible] his season, is

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[*] The following publications may be consulted for further information on this subject: Leopoldo Cicognara, Del distacco delle pitture a fresco. Articolo estratto dall' Aetologia di Firenze, 1825. Vol. 18, num. 52.—Girolamo Baruffaldi, Vita di Antonio Contri, pittore e rilevatore di pitture dal muro, Venezia, 1834.—Cenni sopra diverse pitture staccate dal muro e trasportate su tella, &c. Bologna, 1840.

melancholy; one man says he had *no imagination*, because he painted his bottles and pans from nature!—another, he had no genius, because he took so much trouble and made so many drawings of one thing, hand or foot!—a third, that he painted circumstance and not character!—what has imagination to do with a brass pan?—what is wanted in a brass pan or a bottle, is, the reality of a brass pan and a bottle; now, that painting those things from the realities, instead of trusting to his memory, argues no imagination, is rather refined. Again, as to his taking trouble, who took more trouble than Raphael? had *he* no genius because he took trouble to be perfect in comprehending the objects to convey his thoughts? "Draw the naked figure first," said a connoiseur to a young artist, "as Raphael did." "Oh," said the young man, "*that* would be *losing time*;" no, my young friend, it would be gaining time and not losing, and when fresco begins you will find it out.

The Breakfast is another of his best works, and perhaps The Servant Girl pouring out the Water, is more like a woman, than any other he ever painted of that beautiful sex.

Thus then for ever ends the exhibition of a collection of this extraordinary man's works; his genius first startled the school from its slavish imitation of Reynolds; and though a great æra is commencing, that æra I have always foretold and laboured hard to produce, I can imagine no period of excellence that may hereafter arise, wherein the works of David Wilkie may not be studied, with benefit and instruction, either for fresco or oil.

Poor Sir David!—how many days we have passed in early life!—after painting all day, we met at dinner, and hurried to the Academy from 6 to 8—then went home to each other's rooms to criticize and advise on our mutual labours, animating each other with fresh hopes, and parted for the night with ardent aspirations for fame and distinction. Lord Mulgrave was our employer and kind friend, at his table we used to meet the first men of the time; Lord Mulgrave was a noble character, and had great delight in the society of artists and connoiseurs—after the fatigues of office, nothing pleased him so much. What reminiscences I could write—what a guide book for students would our mutual lives be, our mutual hopes, our mutual anxieties, our mutual fears, our mutual victories, our mutual defeats. A frequent guest was George Colman, whose wit and fun were perpetual sources of sparkle; Lord Mulgrave's brother had attempted to discover the North Pole; a series of pictures relating to the attempt hung round the dining parlour; before leaving the room, long discussions used to take place on art, the whole party walking round; in Captain Phipp's hand was a boat-hook; Sir George Beaumont once said "What has he got in his hand?" "Why," said Colman in his burly joking voice, "*I take it to be the North Pole!*"—At another time, after dinner everybody at table seemed sullen and indigestible—*we* had been painting all day, and were exhausted—Lord Mulgrave was exhausted and said nothing—and there was silence so long, that all of a sudden the whole circle made a sort of spasmodic effort to say something; Sir George in a lazy sort of a way observed "Theodore Hook is a delightful fellow." "Is he," said Lord Mulgrave, with a look at us all, "*I wish to God he was here now;*" this put everybody laughing, and the whole evening was delightful.

The going to the Academy every night, we always considered a necessary winding up of a days' study, but the theatres Covent Garden and Drury Lane were sources of dispute—when Mrs. Siddons acted I used to appeal to Wilkie, and when it was Mother Goose he used to dwell on the bill, and insist on it, he wanted *to study the expressions in the pit!*—sometimes he saved me from temptation, and sometimes I saved him! Once in going home through the Piazzas there was a show, a man in a thundering voice was explaining its wonders; as if by instinct we squeezed in, and getting up in a dark corner, hoped not to be seen; at last in dropped one after the other 16 students—long before they were all in recognition took place, so that a hearty shout welcomed every new face to its utter dismay; many of them are now living, the most distinguished artists of the day; the show was the Baker and the Devil, and it is impossible for people who are never worn out by 10 or 12 hours' painting, to comprehend the relish of students for such absurdities.

To travel with Wilkie was entertaining; in 1814, we went to Paris, and saw the town in its glory; we were joined by a Lincolnshire gentleman, who added much to our pleasure, and the only time I ever saw Sir David yield to a true "abandon," was coming out of Rouen; champaigne had got to his heart, and opened its natural sources; we we were in an open carriage, and I proposed we should sing "God save the King," as we left the city. Wilkie joined most heartily, and on passing into the road, an elegant Frenchman and two graceful women stopped to look at us with pleasure and astonishment!—as we concluded the last line, he turned from us smiling, and said "*Ah! trois milords.*"

But enough—when a dear old friend goes first in the maturity of life, one is apt to dwell too long on days which are passed for ever.

B. R. HAYDON.

PROTECTING CHURCHES FROM THE EFFECTS OF LIGHTNING.

[The following communication appeared in the *Times*, we believe it to be from the pen of Mr. Hood, whose scientific attainments entitle the paper to the especial notice of architects.]

Many persons are of opinion that fatal effects from thunder storms are more frequent now than they were formerly. I should myself be of that opinion if I trusted merely to the records of memory, but I find that, for more than half a century, the same opinion has been held; while at the same time observations made at different periods certainly negative this conclusion. Although it would be attented with much labour to collate all the accounts of accidents of this description, we may gather from the tone of the writers of former days what was the general impression on this subject. The *Philosophical Transactions of the Royal Society*, as well as many of the scientific periodicals published at the close of the last and the beginning of the present century, contain numerous interesting accounts of the effects of lightning; and a writer in the year 1811 states that he has made calculations of the average amount of damage by lightning in England, which he finds amounts to about £50,000 in money, and from 20 to 30 human lives, as the annual sacrifice by this destructive agent.

But it is extraordinary that, notwithstanding this acknowledged loss and destruction, scarcely anything is done to mitigate its effects. Science is certainly able to mitigate these destructive effects, if it were put in requisition for this purpose. The vast number of churches which have been damaged by lightning within the last three or four years—of which the last instance is St. Martin's Church, the damage to which is estimated at £3,000—suggests the necessity for adopting some mode of protecting this description of buildings, for it is certainly most extraordinary that buildings which from their height and general form are more liable than any others to suffer from lightning should so very seldom have any means of protection. With the exception of St. Paul's Cathedral, I believe very few churches in England, either in the metropolis or elsewhere, are furnished with lightning conductors, while many, or indeed most of them, are so constructed as almost to invite the electric fluid without the means of afterwards allowing its escape, except by the destruction of some part of the building. It is singular how nearly identical are the records of all the accidents of this kind which have hitherto occurred. In 1674 St. Bride's Church, Fleet-street, was struck with lightning; the electric fluid entered at the top of the spire by the gilded vane, from which it descended as far as any metallic conductors extended, and then burst through the resisting medium of the stonework, shattering the steeple and throwing down several stones, one of which, weighing 70lb., was carried a distance of 50 yards, and fell through the roof of a neighbouring house. With slight variations this would describe most of the accidents to churches from lightning; the force of the discharge of course depending upon circumstances. Nearly all writers on this subject are agreed, that if churches and other similar lofty buildings were provided with proper conductors, not only would they be protected from the lightning, but they would, in most cases, also defend the neighbourhood from its effects, by silently and imperceptibly drawing off the electricity from the clouds, and thus preventing the violence of the thunderstorm. In fact, this mode of preventing thunderstorms has been often proposed for adoption on a large scale: and it is somewhere narrated (though I cannot now recollect the precise authority) that a village in France, which from some local cause had been repeatedly devastated during a series of years by storms of lightning and hail, was afterwards completely protected by the erection of a number of elevated conductors. It is true that it has never yet been clearly ascertained the greatest extent of surface which a lightning conductor will protect, and, therefore, the precise degree of protection to the neighbourhood may be questioned, except within a certain limited distance—the protecting power of a conductor having been ascertained to be at least sufficient for an area represented by a circle whose radius is twice the length of the conductor.

The best practical instructions for the erection of lightning conductors is the report made to the French Government by M. Gay-Lussac, on behalf of the Academy of Sciences at Paris, published in the *Annales de Chimie*, and also in the 24th volume of the *Annals of Philosophy* for 1824; but, as these volumes are not often in the hands of practical men, it would be most desirable if the Royal Society would publish, in some form applicable to the intended purpose, instructions on this subject, combining the improvements which science has suggested since the period of M. Gay-Lussac's report. It is by no means improbable that many parishes might be induced to erect conductors on their churches, but the subject is so little understood that no one ventures to propose it; and unless these conductors are properly erected they are more likely to do harm than good.

The old cathedral of St. Paul's was twice struck with lightning, and both times seriously damaged. In 1444 the lightning destroyed the tower of the church, and in 1561 it set the church on fire and nearly burned it to the ground. In 1769 the Dean and Chapter applied to the Royal Society for their advice as to the best means of securing the present cathedral from the effects of lightning, and a short description of the mode adopted in this immense edifice may be interesting.

The ball and cross are supported by seven iron rods; these rods are then connected with other rods (used merely as conductors) which unite them with several large bars descending obliquely to the stone work of the lantern. A ring made of iron, one inch square, connects all these bars, and four iron bars, one inch square, connect this ring with the lead covering of the great cupola, a distance of 48 feet; and from thence the communication is continued by means of the pipes which discharge the water on to the floor of the stone gallery. From these pipes large strips of lead connect them with the pipes which discharge the water on to the roof of the building. This roof is entirely covered with lead, and from thence the communication is continued to the ground by means of the lead water pipes, which pass into the earth, thus completing the entire communication from the cross to the ground, partly through iron, and partly through lead. On the clock tower a bar of iron, one inch and a quarter square, connects the pine apple at the top with the iron staircase, and from thence with the lead on the roof of the church. The other tower has a bar of iron of the same size extending 88 feet from the pine apple to the roof of the church. By these means the metal used in the building is rendered available for the purpose of the conductors, the metal employed merely for the conductors being exceedingly small in quantity.

The general neglect of the use of lightning conductors probably arises from the belief of their insufficiency and ignorance of their proper construction. But it can be satisfactorily shown that wherever they have failed to afford protection it has arisen from either defective construction or subsequent derangement.

Earl-street, Sept. 6. H. C.

GREAT BRITAIN STEAM SHIP (LATE MAMMOTH).

The Mechanic's Magazine, No. 996, gives an account of the construction and dimensions of this ship, together with drawings of her machinery and its arrangement, explanatory, although necessarily drawn to a very small scale; and useful, could we depend upon their accuracy; but the author (Mr. Hill) tells us "his rough dimensions were obtained by pacing, others by a graduated walking stick," a system of mensuration somewhat unusual among engineers of the present day. From the materials there furnished we form the following calculations:—

The diameter of each cylinder is said to be 88 inches, the stroke 6 feet, which at 19 strokes per minute, or 228 feet, is equal to 295 horses each, or of four cylinders to 1180 horses, and not of 1000, as stated by the author. Thus, area $\frac{88 \times 7 \times 228}{33,000} = 294.15$ horses or 1176.60 for *four engines*, doubtless intended to be of the collective power of 1200 horses, which in fact an additional ¼ of a stroke per minute would produce. The air pumps at 3′ 9″ diameter and 6′ 0″ stroke have a content of 66.24 cubic feet; *one* pump and condenser being apportioned to *two* cylinders. The cylinders have a content of 253.38 cubic feet; both = 506.76 cubic feet, we have therefore $\frac{506.76}{66.24} = 7.7$ times, or about the proportions of our best engineers. The condensers are 12.0×8.6×5.0. content = 510 cubic feet, here we have $\frac{510}{66.24} =$ 7.65 times, or nearly thrice as much as experience shows to be necessary. If any dependence is to be placed on the boiler sketches, the Bristolians have yet much to learn in that department of marine engineering. We are inclined to doubt their authenticity, for having so good an example as the boilers of the Great Western before them they ought to have certainly produced something nearer perfection, but of course we can only reason on what is before us. For example, we have 24 fires, each 6 feet long by 2 feet wide, a total grate surface of 288 feet for 1200 horse power, or about ¼ of a foot per horse power (nominal) or *less than half the proper quantity*. This fact, coupled with the indifferent arrangement of the flues, are plain indications that the consumption of coals will be the reverse of economical.

We make this analysis with reference to an article on "The Great Britain, the largest vessel in the world," published in the *Times* last month, wherein it is stated she has stowage for 1000 tons of coals and 1200 tons of measurement goods. The former amount seems inadequate for the purpose intended, viz., a voyage from Bristol or Liverpool to New York.

If we take the consumption at the moderate computation of 8 lb. per H.P. nominal per hour, we have 1200 × 8 = 9600, or per day = 103 tons; and supposing an average passage 12 days, the consumption would in that time be 1236 tons of coals without any surplus for the contingency of bad weather and prolongation of voyage. We think the consumption of coals will be nearer 10 than 8 lb. per horse per hour; and if we are correct in this opinion, we have 1200 lb. per hour, or, 129 tons per day, or 1548 for a voyage of 12 days—and mind, no surplus.

But, will she make the passage in less than 12 days? The same authority informs us that her load line is at 16 feet; at this, her immersed section is about 600 feet. Taking the powers as the cubes of the velocities, and using the factor 1400 (which experience shews to be correct for this class of vessel) we have $\frac{1400 \times 1200 \text{ H.P.}}{600 \text{ section.}} = 2800 =$ 14 miles per hour in still water, presuming her to be propelled by paddle wheels; but according to the Great Western experiments, as stated in Mech. Mag. p. 255, the screw *is inferior* to the wheel in the proportion of 12 to 10, or one fifth, so that instead of 14 miles her true velocity will probably be 11.65 miles, in still water, as aforesaid.

Now, Cunard's packets attained a greater velocity than 11.65 miles when tried experimentally, and yet their average passages, show a *sea* speed of about 8½ miles only, the average length of passage being 13 days 16 hours out, and 11 days 5 hours home. The passage out gives 7.86 miles per hour, while that home influenced by prevailing wind and current gives 9.3 miles, in this case the mean sea rate is 8.58 miles per hour.

We take these facts from the *Nautical Magazine*, subsequently published in the *Times*, it appears to be a compilation from registered results, and therefore entitled to the highest credit. It states the passages of Cunard's line to be *outwards*, from 10 days 19 hours to 16 days 12 hours, and one reached 20 days 17 hours; the *home* passage from 9 days 17 hours to 12 days 18 hours, and this between Liverpool and Halifax only.

We draw two conclusions from these data: the first, there is no reason to suppose the Great Britain will make quicker passages than the present vessels; the second, that provision should be made for 20 days consumption of fuel, for we need not point out to our nautical readers the position of such a vessel in the broad Atlantic, *minus* her steam power, rigged as she is. What then becomes of the 1800 tons space for measurement goods? Supposing this vessel buffetted about for upwards of 20 days (as one of Cunard's superb vessels has been), she would require stowage for 103 tons × 20 days = 2060 tons of coals at the moderate computation of 8 lb. per horse per hour; if we reduce it to the minimum of safety, say 16 days stowage, we require 1648 tons. at 8 lb. per horse only; which we may say is the general average of the best and most economical boilers. We know enough of marine engineering to state confidently that the boilers of the Great Britain will not reach this point.

We hope we may not be misunderstood, and our remarks considered inimical; our desire is simply to correct what we believe to be erroneous conclusions and to put the proprietors on their guard, that they may be moderate in their expectations. It would conduce to our utmost pleasure if their most sanguine expectations become realized, not in the narrow spirit of pecuniary gain, but as a national triumph and convincing proof that Great Britain is, and ever shall be, mistress of the seas.

"THE LIGHT OF ALL NATIONS."

The laudable attempt of Mr. Bush to construct a light-house on the Goodwin Sands, is now occupying public attention, we have, therefore, obtained the following particulars of the construction of the caisson and its progress, which we hope to be able to follow up in next month's Journal, with a drawing, and an account of the works as they progress. We are happy to hear that up to the present perio withstanding some severe gales and squally weather, M proceeded very successfully, and fully equal to his m pectations. We sincerely hope that his praisewor crowned with success.

The caisson, which is of cast iron, is 30 feet in diameter at the base, and is of a conical form, diminishing upwards 1 in 5. It is formed of a series of plates, with flanches at the joints 3 inches in width. and connected together by ½ inch wrought iron bolts. Each tier of plates is 6 feet in height; the lower tier is 1½ in thickness, the circumference is divided into 24 plates as are the other courses above, which are respectively arranged so as to break joint. Within the lower tier the working chamber is constructed, in which the process of excavation will be carried on as in a diving bell, and the spoil discharged through a 4-feet aperture in the centre of its domed top into the second chamber. The chamber above is fitted with air-pumps, gauges, and apparatus for regulating the supply of air to the workmen in the working-chamber; and from the second chamber proceeds a 4-feet cylinder extending upwards through the centre of the caisson for the further discharge of spoil. The height of the chamber above will be regulated by the depth to which it may be necessary to proceed before the chalk is arrived at, plates being added to the caisson as its descent is effected through the sand. By means of valves and man-holes, &c., the two lower chambers communicate with each other as far as it is necessary for the supply of air for the workmen, and the discharge of the sand during the process of excavation, which will be carried on from within, similar to the sinking of a shaft or the kibt of a well, the lower chamber acting in this respect as a diving bell, by which the work is carried on under water, and through the cylinder at stated periods, when external communication is cut off from the lower chamber, the spoil will be discharged into the sea. The caisson has now descended 24 or 25 feet in the sand, or about 30 feet below low water mark; the tide rises about eighteen feet, and from various indications combined with the general stability of the machine, it is presumed to rest at present near the solid chalk. When the caisson shall have been brought upon a level bed, and the sand excavated, the interior will be filled up with solid masonry and concrete, npon which foundation the light-house is proposed to be erected.

PATENT RELIEVO LEATHER HANGINGS.

We feel much pleasure in directing architects to the very great improvements made in Messrs. Leake and Co.'s *Patent Relievo Leather* hangings, panels, imitation oak carvings, &c., of which they have an endless variety at their offices, 52, Regent-street. Her Majesty and H.R.H Prince Albert have more than once had a large variety of patterns sent to Buckingham Palace and Windsor Castle for their inspection; and have shown their excellent taste in selecting many beautiful examples, for decorating step of the state apartments both at Windsor and Buckingham Palace. The designs are very beautiful; indeed it is difficult to discover that some of the patterns are not *carvings in wood*—so closely imitated are the chisel marks, the grain of the wood, the undercutting, and its assimilation of colour to the best oak and walnut carving of the middle ages. The hangings, friezes, heads, fruits, &c., in the various rich and elaborate styles of decoration prevalent in Spain, Italy, France, and Germany, as well as our own Eliazbethan, are here brought to their greatest perfection, and will bring about a decided improvement in our present mode of decorating public buildings, the baronial residences of our nobility, churches, &c. The cost of these ornaments is about half the price of carvings in wood.

IMPROVEMENT IN COATING OR COVERING METALS.

Mr. Henry Fox Talbot, of Laycock Abbey, Wilts, has obtained a patent for improvements in coating or covering metals with other metals, and in colouring metallic surfaces.—They are four in number. The first consists in adding gallic acid to the metallic solutions intended to be preciptated. Any convenient solution of silver, gold, or platina is taken: and to each of them is added a solution of gallic acid, in water, ether or alcohol, (the last being preferred.) Into any one of these mixtures a clean bright plate of metal is immersed until it becomes coated with silver, gold, or platina, as the case may be. A weak or dilute solution is recommended to commence with, and afterwards a stronger one. The acid need not be pure. The second is a method of silvering metallic surfaces. Freshly precipitated chloride of silver ir dissolved in hyposulphite. Into this solution a clean bright plate of metal is immersed, and becomes very quickly coated with a bright silver coating. To obtain thicker coats of metal, a galvanic battery is employed, using one of the liquids before described, and taking for one of the poles a piece of metal of the same kind as that intended to be precipitated. The third is a method of ornamenting surfaces of brass or copper, by first gilding them partially, according to some pattern, and then washing them over with a solution of chloride of platina, which gives a dead black appearance to the rest of the surface, and enhances the brilliancy of the parts gilt. The fourth is a method of colouring polished surfaces of copper, by exposing them to the vapour of sulphuretted hydrogen, or any of the liquid hydrosulphurets, or to the vapours of sulphur, iodine, bromine, or chlorine, or by dipping the metals into liquids containing them. The claim is to the use of the gallic acid, or any liquid containing it, or any analagous vegetable substance for facilitating the precipitation of metals upon other metallic surfaces, and coating them therewith —to the use of hydrosulphate of soda for the silvering of metals, and the employing a galvanic battery for obtaining thicker deposits of silver, gold, or platina, but only when used in conjunction with one of the liquids so described: and to the colouring of copper surfaces by exposing them to the chemical action of the above-named substances.

IMPROVEMENTS IN DAUGUERREOTYPE.

M. Claudet, of High Holborn, and Adelaide Gallery, has obtained a patent for improvements in the process for obtaining images or representations of nature or art. They are five in number. The first consists in making in the front of the camera obscura an aperture large enough to admit object glasses of various foci, so as to have either large or small plates, and obtain images of near or distant objects. The second consists in substituting for the detached mercury box ordinarily employed, a cup of mercury placed within the camera, and heated by a spirit lamp till the mercurial vapours rise and fill the camera. The light and mercury are made thus to act simultaneously on the plate, whereby a more intense and perfect image is obtained. In the side of the camera there is an eye-hole, covered with red or orange-coloured glass, through which the operator may watch the process. and be thus enabled to withdraw the plate the instant the proper effect is produced. The third consists in placing immediately behind the sitter for a portrait, painted back grounds or scenes, representing landscapes. interiors of apartments, &c., which, being thus brought within the range of the Dauguerréotype apparatus, are transferred to the plate, as well as the portrait of the sitter. The fourth consists in the employment, in the absence of daylight, of an artificial light, produced either from the combustion of coal, promoted by a jet of oxygen gas, or from combustible gases and carbureted liquids burning together with oxygen: or from a solid refractory body suspended in a jet of inflammable gas, &c. Care must be taken that the burner is fixed exactly in the axis of the reflecting mirror, or that the greatest light falls on the centre of the curve. The fifth and last improvement consists in performing the whole process in a lighted room instead of in the dark, as has been hitherto the case. A white light must, however, be avoided, and screens of red, orange, green, or yellow, are therefore employed. Of these colours red is preferred, as having the least injurious effect on the plates.

A New Forging Machine.—This machine for the working or forging of iron, steel, &c., is quite portable, occupying only a space of 3 feet by 4 feet, and cannot be deemed other, even by the most critical judges than one as purely original in principle, as well as practical in its application. It may be worked by steam or water power, and when moved by the former at an exhibition it made 650 blows or impressions per minute; but from their very quick succession, and the work being effected by an eccentric pressing down, not striking the hammer or swage, not the least noise was heard. There are five or six sets of what may be called anvils and swages in the machine, each varying in size. The speed and correctness with which the machine completes its work, is perfectly astonishing, and must be seen in order that its capabilities in this respect may be duly appreciated: for instance, when it was put into motion for the purpose of producing what is known as a roller, with a coupling square upon it, (and which had to be afterwards turned and fluted,) the thing was accomplished in fifty seconds! of course at one heat, to the astonishment of the bystanders. But what appeared as the most extraordinary part of the affair, was, that the coupling square was produced direct from the machine, so mathematically correct, that no labour can make it more so! The machine will perform the labour of three men and their assistants or strikers, and not only so, but complete its work in a vastly superior manner to that executed by manual labour. For engineers, machine makers, smiths in general, file makers, bolt and screw makers, or for any description of work parallel or taper, it is most specially adapted; and for what is technically known as reducing, it cannot possibly have a successful competitor—in proof of which it may be stated, that a piece of round iron 1¾ inch in diameter, was reduced to a square of ⅜ in., 2 ft. 5 in. long. at one heat. The merit of this invention belongs, it is said, to a gentleman at Bolton, of the name of Ryder.—*Leed's Mercury.*

Improved Door Knobs.—A patent has been obtained bv Mr. Daniel Greenfield of Birmingham for improvements in manufacturing hollow metal knobs for the handles of door and other locks; the essential character of the improvement being that of forming an interior lining of stamped iron-plate to the hollow-ball part of the knob, and (in case it is preferred) an interior of cast-iron to the neck part of the knob, in order, by means of such stamped-iron and such cast-iron (if the latter be used) to give support to the brass, German silver, or other metal, whereof the exterior surface of such knob is or may be composed."

ENGINEERING WORKS.

SUSPENSION BRIDGE OVER THE DANUBE.

On the 24th of August, the ceremony of laying the foundation-stone of the suspension bridge now being erected across the Danube, to unite the cities of Pesth and Buda, was enacted. Of the gigantic work now in progress, two coffer dams, unequalled in cubical dimensions by any ever yet constructed, are now completed and water tight, being those on the Pesth side, whilst those on the Buda side are in an advanced stage. That destined for the sustaining pier on the Pesth shore was the scene of the display: it was fitted up as a vast saloon, with graduated seats all round it, to acommodate 2,000 people, with a "*loge*," or box, for the royal party. Shortly after 5 o'clock p. m. a discharge of artillery announced the departure of the Royal *cortège* from the Palatine's Palace at Buda, and in due time the Archduke Charles, descended the spacious stairs made in the framework of the dam, accompanied by the Palatine, his Archduchess, and their two children, the flower of Hungary's nobles, the magistrates and officials of the cities, aides-de-camp, and, amongst others, Mr. W. Tierney Clark, the engineer of this gigantic work. Their highnesses having reached their places, remained there to hear read, and to sign with others the inscription, in Hungarian, to be placed beneath the foundation-stone; which being done, it was. with the coins of the realm, placed by the engineer in its destined bed, and on a signal being given by him, the "traveller" (the machine for raising, lowering, and setting the ponderous masses of stone in such works) was moved forward from the other end of the dam, bringing with it a block of granite of about 90 cubic feet in size, and which, being lowered and fixed in its berth, the Archduke Charles was presented by the Baron Sina with a gorgeous and elaborately-worked gold and silver trowel (executed by Messrs. Mortimer and Hunt, of London) and mallet, and thereupon the usual ceremony of applying both to the stone was gone through by his Royal Highness, and then by the Palatine, his wife and children, the Primate, the magistrates of the city, the Baron Sina, the Count Stephen Izchenyi, and the engineer, which being communicated by the hoisting of a flag to those without, a response was given by a discharge of 25 cannon, and thus closed this interesting and splendid ceremonial. It is not the least interesting part to know, that this great work, is from the designs, and under the direction, of our distinguished countryman Mr. W. Tierney Clark, F.R.S., civil engineer, to whom the Archduke Charles on this occasion, in the name of the Emperor, presented a gold snuff box, with the cypher of the imperial donor emblazoned on it in magnificent and large brilliants. To Mr. Adam Clark, the resident superintendent of the work, his Highness presented a gold box, set in brilliants, and gave 100 ducats (£50) to be distributed amongst the men employed. The trowel, on which is a representation of the proposed work in basso relievo, with the mallet, has been handed over by the Archduke to the national Museum, as a memorial of the day and undertaking.

THE TELEMAQUE TREASURE SHIP.

The following extracts from a private letter in the *Times* will be found to contain much interesting intelligence respecting the raising of the Telemaque, which was sunk in the Seine, near Quillebœuf, about 50 years ago.

"My attention was attracted by a pile of timbers rising out of the river, at a short distance from the quay at Quillebœuf, on which a number of men, whom by the silent energy of their movements I recognized as English, were hard at work. These were the preparation for raising the treasure-ship. I was politely received by Captain Taylor, one of the chief adventurers in this speculation, and the conductor of the operations, who during my stay took pains to give me every possible information on the subject in which I was interested.

"It appears from minute examination by soundings and by divers, that the Telemaque is lying on her side on a bed of sand and rock, in about eight feet water at ebb tide, a drift of mud sloping the height of her deck, but on the other side half of her bottom above her keel is entirely clear. The parties who have hitherto attempted to raise her have proceeded on a plan which has often succeeded in tolerably smooth tidal waters. They have passed chains round the vessel at low water, carried the ends of these chains into two large barges moored at the head and stern of the Telemaque, and then expected that as the tide rose the barges would raise the sunken brig by the chains. But as the tide in the Seine rushes up in a sudden and lofty wave or bore, the barges were dashed up suddenly, and the chains were either disarranged, or, being unequally strained, broke.

"Captain Taylor has moored a barge near the wreck, and upon it he has established his head quarters. Thirty picked English workmen live there night and day, taking advantage of every favourable hour of the tide. In the barge they have their workshop, their forge, and berths, and kitchen, all quite man-of-war fashion. The first operations of this last undertaking were commenced by driving wooden piles pointed with iron, and on these piles a stage has been erected so as to form a solid superstructure or bridge resting over the Telemaque. Iron harpoons with barbed points were then driven right through the vessel, and chain cables were passed round the bow and the stern, and longitudinally from the stem to stern of the vessel. The next process will be to fix powerful screw-jacks, and then by them, slowly and evenly worked, to raise the brig.

"As soon as it is raised a few inches from the bed where it now lies, cable chains, worked by powerful capstans on shore, will be attached to it, and the wreck slowly dragged toward the quay into a position where it will be high and dry at low water.

OPENING OF THE SOUTHAMPTON DOCKS.—The tidal dock of this great national commercial undertaking was opened in the afternoon of Aug. 29th. The dock is said to be the largest in England, the inside, from wall to wall, covering an area of sixteen acres. It is excavated to that extent, that there will be always eighteen feet water at low water spring tides. The opening is 150 feet in width, thus admitting vessels of almost any tonnage. A shed is now building on the north-east side, 360 feet in length, and fifty feet wide in the floors, for the storage of goods, from which a tram-way leads to the railway station, distant about 300 yards. This dock was commenced three years ago (this month), at a cost of about £140,000., and, had it not been for unforeseen causes, would have been opened for traffic some time since. The vessels belonging to the Peninsular and Oriental and the Royal West India Mail Company, will henceforth make use of it; and no doubt every vessel of consequence will take advantage of the facilities thus offered for landing and shipping goods. The latter company have contracted for the use of a portion of the dock for the sum of £2,000 per annum. There is another dock, now in progress, called the inner or wet dock. It is impossible to state when this will be finished. Want of funds prevents that accomplishment for the present. This dock covers an extent of fourteen acres, and is the nearest to the town.

BOULOGNE HARBOUR.—We understand it is definitively settled that our jetties are to advance 600 yards further into the sea, so that vessels drawing 12 feet water, will be enabled to enter them at all hours of the day and night. When they will be commenced is one question—but when finished is another. Our English readers must not imagine that we—no, not we, but the *Ponts et Chaussées*—have yet to learn how to go ahead by steam, as our unfortunate harbour too plainly demonstrates.—*Boulogne Gazette.*

COLCHESTER NAVIGATION.—The plan for constructing a ship canal from Wivenhoe to the Hythe, as laid before the public in Mr. Bruff's plan and report has, we undstand, met with a very favourable reception among our trading community, who are of course the best judges of the merits of such a plan, and of the benefits derivable therefrom. The possibility of constructing such a work for a very moderate sum (Mr. Bruff states £56,000, exclusive of the land) gives it a powerful claim to public attention, and the advantages Colchester would derive from its establishment are obvious.—*Essex Standard.*

Newcastle-upon-Tyne.—The banks of the Tyne at Newcastle are very abrupt, and the breadth of the river about 620 ft., over which a timber bridge is projected on the plan of the viaducts on the Shields railway, the centre arch of which is intended to be 280 ft. span, and 100 ft. above high water at spring tides. The estimated cost is £100,000, proposed to be raised in 5000 20*l.* shares. The number of passengers per week traversing the present bridge is 170,000, one-third of which, it is expected, would pay toll: but the project does not progress. What a splendid opportunity here presents itself to adopt the use of iron to its fullest extent, especially as the price of that material is so unprecedentedly low, and the facilities of casting large pieces and quantities has so much increased.—*O. T.*

Whitby Pier.—This pier has been lengthened, and is now about half a mile long. In a very short time it will be open to the public, and we have no reason to doubt but that it will equal most of the piers in England.—*Hull Advertiser.*

STEAM NAVIGATION.

East India Steam Navigation.—The steamer *India* having performed her last voyage from Suez to Bombay against the height of the monsoon, a circumstance unprecedented in the annals of navigation, it may be interesting to compare a statement of that steamer's performance on her last two voyages, the first having been made in the fair season, and the second against the strength of the monsoon. On her first voyage the *India* left Calcutta on the 10th of January last, and steamed to Suez in 25 days and 14 hours, running 4,849 miles, or 182½ miles per day, consuming 680 tons of coal, or 7·6 lb. per horse power per hour. On her second voyage she left Calcutta on the 9th of May, and steamed in 34 days 4,658 miles against the wind, averaging 137 miles per day, and under sail four days; total distance 5,089 miles, consuming 900 tons of coals, or 7½ lb. per horse power per hour. This result is most important, as showing that the communication by steam can be kept up with the eastern side of India at all seasons of the year. On the first voyage the Calcutta letters reached London in 46 days; the second voyage her letters were detained 24 days in Egypt waiting a conveyance.—*Hants Independent.*

The James Watt.—Messrs Maudslays and Field have received Government to proceed immediately with the engines of 800 H

Cherokee.—The engines sent out to Canada for this vesse manufactory of Messrs. Maudslays and Field.

FRENCH STEAMERS.

The following list of vessels is from the *Railway Moniteur*, with the ports at which they are being built, and the names of the engineers who are making the engines. They are 14 in number, of 450 H. P. each; the *Ulloa, Columbus*, and *Labrador* have been already launched, and it is expected that they will all be ready for sea in the course of next year.

NAME.	PORT.	ENGINEER.
Darien	Cherbourgh	M. Cavé, of Paris.
Ulloa	Ditto	
Christopher Columbus	Brest	
Magellan	Ditto	
Cacique	L'Orient	Government Steam Factory at Indret
Eldorado	Ditto	
Carib	Ditto	M. Schneider, of Creuzot.
Canada	Brest	
Labrador	Toulon	
Orinoco	Ditto	
Albatross	Ditto	
Greenland	Rochefort	M. Hallette, of Arras.
Montezuma	Ditto	
Panama	Ditto	
Five War Steamers of 220 H. P. are also being built.		
Espador	Indret	M. Pauwels.
Caimar	Ditto	
Phoque	Bichwiller	M. Stehelin.
Glan	Ditto	
Cuvier	L'Orient	Miller, Ravenhill & Co. of London.

AMERICAN MAIL STEAM SHIPS.—The British and North American Royal Mail Steam Company's new steam ship Hibernia was launched at Greenock on Thursday 8th Sept. The Hibernia is about 200 tons larger and of greater power than the present mail steam ships. Captain Edward C. Miller, formerly of the Acadia, will now command the Columbia. If the new ship only equal, in general efficiency and speed, the four vessels composing the line, she will be a steamer of the first class . That she will equal, if she do not exceed them in those indispensable qualities, the skill and judgment of the managers of the company are sufficient guarantees.—*Liverpool Albion.*

The Hindostan.—This splendid vessel started from the Southampton Docks on the 24th ult. for Calcutta; she is destined for the navigation of the Indian Seas, between Calcutta, Ceylon, and Suez, and forms part of the intended fleet of the Peninsular and Oriental Steam Navigation Company for establishing a communication between England (from the Port of Southampton) and our Indian possessions, *via* Alexandria and Suez; between these two points the communication will be as heretofore, overland. This vessel was built by Messrs. Wilson, of Liverpool; her length of keel is 220 feet, length over all 250 feet, beam inside the paddle-boxes 39 feet, depth 30½ feet, burden 1,800 tons; engines, 550 H. P. constructed by Messrs. Fawcett & Co., the eminent engineers of Liverpool. She is fitted with Captain Smith's safety paddle-box boats, which are so large that the whole of the crew and passengers could be taken in them in any sea. She has also four large quarter boats and stern boat. She is divided by wrought-iron water-tight bulkheads into five compartments. In our next number we shall give some further particulars of this splendid vessel.

Gloucester and Ledbury Canal.—The feeder at Canon Froome, for supplying the canal with water, has now been put in operation. It is expected that in two months boats wlll be able to come up to Castle Froome.—*Hereford Journal.*

Portsmouth.—A new steam-frigate called the Firebrand, was launched at this dock-yard on the 5th inst. She was immediately taken into dock to be coppered, and will, as soon as fitted with her engines, be commissioned. Her original name was the Beelzebub, but when the Firebrand, after bringing over the King of Prussia to this country, had her name altered and was called the Black Eagle, the Beelzebub was changed to the Firebrand. Two other first class steamers are building at this dock-yard called the Scourge and Centaur.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM THE 31ST AUGUST, TO 22ND SEPTEMBER, 18 2.

Six Months allowed for Enrolment, unless otherwise expressed.

CHARLES FREDERICK GUITARD, of Birchin-lane, notary public, for "*improvements in the construction of railways.*"—Sealed August 31.

CHARLES THATCHER, of Midsomer Norton, Somerset, brewer, and THOMAS THATCHER, of Kilmersdon, in the said county, builder, for "*improvements in drags or breaks to be applied to the wheels of carriages generally.*"—August 31.

ROBERT HAZARD, of Clifton, near Bristol, for "*improvements in ventilating carriages and cabins of steam-boats.*"—September 3.

WILLIAM ROCHE, of Prince's-end, Stafford, mechanic and engineer, for "*improvements in the manufacture of mineral colours.*"—September 3.

WILLIAM WARBURTON, of Oxford-street, gentleman, for "*improvements in the construction of carriages and apparatus for retarding the progress of the same.*"—September 8.

JOHN WORDSWORTH ROBSON, of Jamaica-terrace, Commercial-road, engineer, for "*improvements in machinery and apparatus for raising, forcing, conveying, and drawing off liquids.*"—September 8.

JAMES INSOLE, of Birmingham, saddlers' ironmonger, for "*improvements in the manufacture of brushes.*"—September 8.

JOSEPH HENRY TUCK, of Francis-place, New North-road, engineer, for "*improvements in machinery or apparatus for making or manufacturing candles.*"—September 8.

WILLIAM EDWARD NEWTON, of Chancery-lane, civil engineer, for "*improvements in machinery or apparatus for making or manufacturing screws, screw-blanks, and rivets.*" (A communication.)—September 8.

HERBERT GEORGE JAMES, of Great Tower-street, merchant, for "*improvements in machines or apparatus for weighing various kinds of articles or goods.*" (A communication)—September 8.

WILLIAM FOTHERGILL COOKE, of Copthall-buildings, Esq., for "*improvements in apparatus for transmitting electricity between distant places, which improvements can be applied, amongst other purposes, to apparatus for giving signals and sounding alarums at distant places by means of electric currents.*"—September 8.

THOMAS THIRLWALL, of Low Felling, Durham, engine-builder, for "*improvements in lubricating the piston-rods of steam engines, and of other machinery.*"—September 8.

WILLIAM CROFTS, of New Radford, Nottingham, lace machine maker, for "*improvements in the manufacture of figured or ornamental lace.*"—September 8.

THOMAS MARSDEN, of Salford, Lancaster, machine maker, and SOLOMON ROBINSON of the same place, flax dresser, for "*improvements in machinery for dressing or hackling flax and hemp.*"—September 8.

JAMES WAKE, jun., of Goole, York, coal factor, for "*improvements in propelling vessels.*"—September 9.

JOHN ROLT, of Great Cumberland-place, colonel in Her Majesty's army, for "*improvements in saddles.*"—September 15.

FREDERICK BOWLES, of Moorgate-street, London, for "*a new method by machinery of preparing flour from all kinds of grain and potatoes, for making starch, bread, biscuits, and pastry.* (A communication.)—September 15.

CHRISTOPHER NICKELS, of York-road, Lambeth, gentleman, and CALEB BEDELLS, of Leicester, manufacturer, for "*improvements in fabrics produced by lace machinery.*

WILLIAM HENRY JAMES, of Martin's-lane, London, civil engineer, for "*improvements in railways and carriage ways, railway and other carriages, and in the mode of propelling the said carriages, parts of which improvements are applicable to the reduction of friction in other machines.*"—September 16.

JOHN SANDERS, WILLIAM WILLIAMS, SAMUEL LAWRENCE TAYLOR, and WILLIAM ARMSTRONG, all of Bedford, agricultural implement makers, and EVAN WILLIAM DAVID, of Cardiff, for "*improvements in machinery for ploughing, harrowing, and raking land, and for cutting food for animals.*"—September 22.

PATRICK STEAD, of Halesworth, Suffolk, malster, for "*improvements in the manufacture of malt.*"—September 22.

JOHN JUCKES, of Putney, gentleman, for "*improvements in furnaces.*"—September 22.

Mr Peter Ewart.— We very much regret to announce the death of Mr. Peter Ewart, of Woolwich Dockyard, many years chief engineer in the Government service, to whom was entrusted the direction of the marine and mechanical engineering establishment at Woolwich; his death was occasioned by a serious accident on the 8th ultimo. Mr. Ewart was present at the testing of a chain cable in the proof-house, when the cable suddenly broke, and a portion of it flying back struck him a violent blow on the body, by which he was driven with great force against the wall of the proof house.

TO CORRESPONDENTS.

Communications received from O. T. *on earthwork and suspension bridges.*—J. W. S. *of New York.*—Mr. Hartop.—Mr. W. Gartland.—Mr. E. B. Rowley, and Mr. Pring.

A correspondent is desirous of knowing the maker's name of iron houses.

Phœnix.—*We are collecting materials for forming a table of the proportions of all our large steam ships and boilers, pressure of steam, &c., and will thank him, or any other correspondent if they will favour us with any information they may possess upon the subject.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant. addressed to the Editor, No. 10, Fludyer Street, Whitehall.

No. 2 has been reprinted and may now be had of the Publishers.

Vols. I, II, III, and IV, may be had, bound in cloth, price £1 each Volume.

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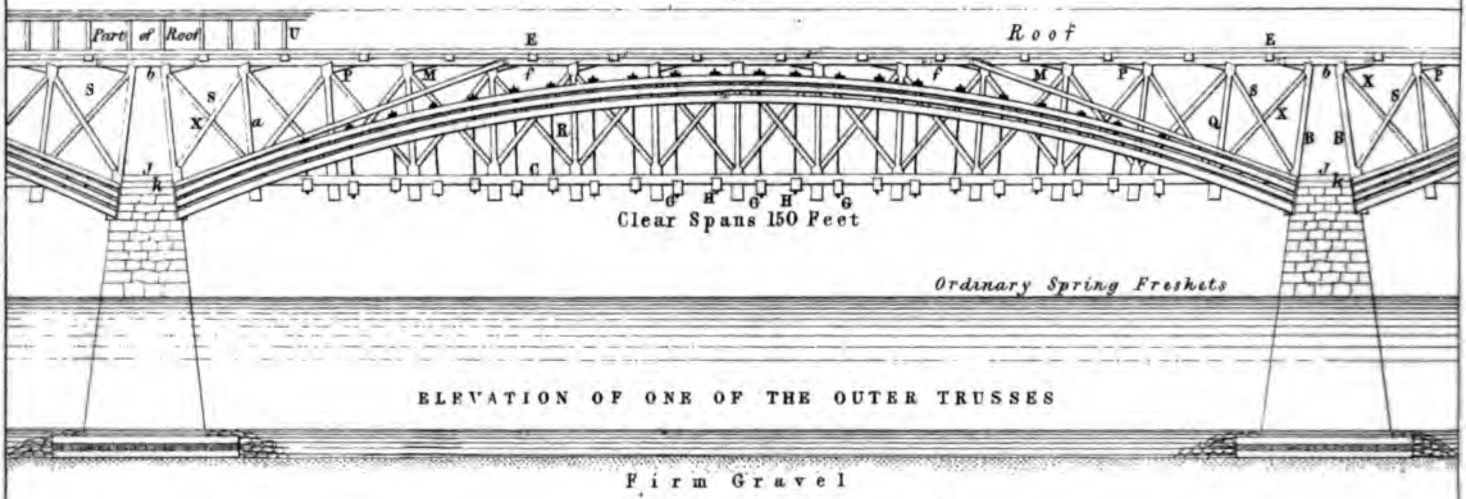
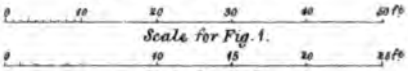
TILDEN FOUNDATIONS

THE PENNSYLVANIA CANAL AQUEDUCT.

Fig. 1.



ELEVATION OF ONE OF THE OUTER TRUSSES



Scale for Fig. 1.

Scale for Fig. 2.

Fig. 4.

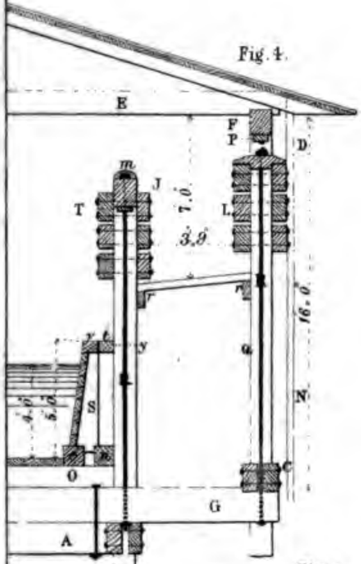
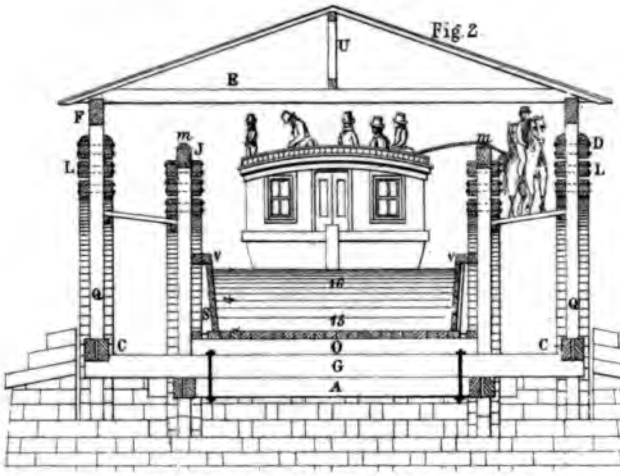
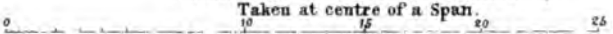


Fig. 2

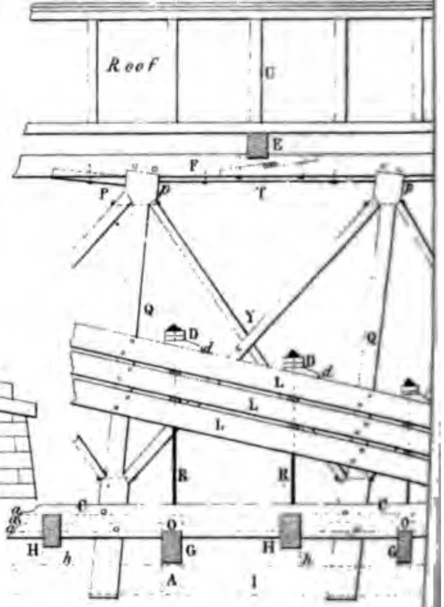


TRANSVERSE SECTION OF AQUEDUCT,
Taken at centre of a Span.



Scale for Fig's 3.4.5.6

Fig 3.



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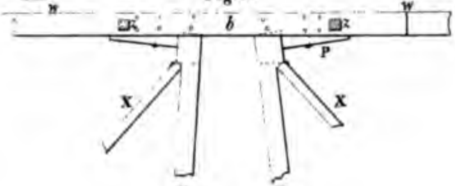


Fig. 7.

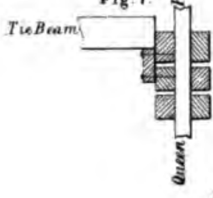
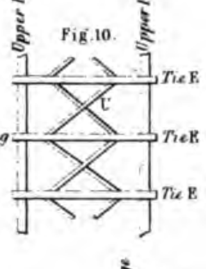
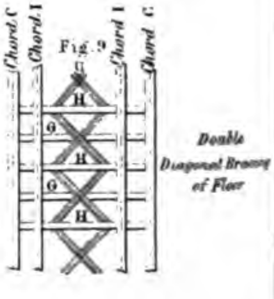


Fig. 10.



Single Diagonal Bracing of Tie Beams

Fig. 9.



Double Diagonal Bracing of Floor

Fig. 6.

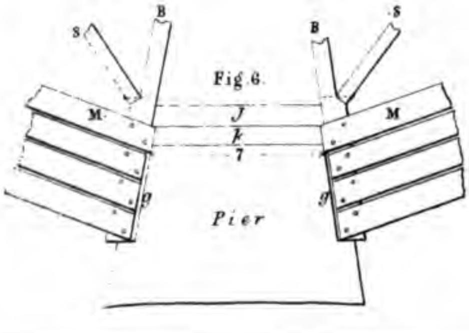


Fig. 8.

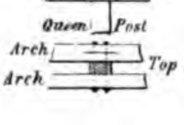
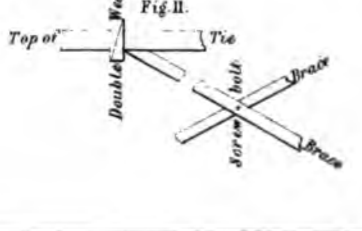


Fig. 11.



J. R. Jobbins, Warwick Ct Holb.

THE PENNSYLVANIA CANAL AQUEDUCT,

(With an Engraving, Plate XIII.)

(FROM THE AMERICAN JOURNAL OF THE FRANKLIN INSTITUTE.)

Description of the Wooden Aqueduct carrying the Pennsylvania Canal across the river Alleghany, at Pittsburg; from actual measurement. With remarks by JOHN C. TRAUTWINE, *Civil Engineer, of Athens, Tennessee, U.S.*

THIS aqueduct was built in the year 1829, by Mr. Lothrop, of Pittsburg, at an expense to the State of 104,000 dollars. It has two abutments and six piers of stone, and seven arches of timber of 150 feet clear span each; the whole length of the aqueduct between the abutments being 1092 feet. The masonry is of cut ashlar, in large courses, with rubble filling. The material is a gray sandstone, rather too soft, in my opinion, for such parts of a structure as are exposed to rapid currents, bringing down heavy fields of ice and drift wood, as is the case with the Alleghany. The piers are 7 feet thick on top; they batter one inch to a foot on the sides, are semi-circular at their down-stream ends, and are provided with break-water starlings. The average height of the piers is about 40 feet.

The timber of the aqueduct is white pine, with the exception of the chords and the pier-posts, which are of white oak, as being better calculated to resist the great strains that come upon them. I conceive, however, that any precaution of this kind would apply with more force to the pole plates, or cap-pieces, as it is well known that the resistance of timber to compression is much less than that to extension. Therefore, if extra precautions are requisite for the chords, they are doubly so for the poles.

The width of the aqueduct, from out to out of weather boarding, is about 34 feet. The height of the trusses, from bottom of chords to top of poles, 16 feet. The canal trunk has a top width of 16 feet, a bottom width of 15 feet, and a depth of 5 feet. The depth of water is generally 4 ft., sometimes 4 ft. 3 in. There are four trusses to each span. These particulars, however, with the other principal dimensions, are so plainly indicated by the drawings as to require no farther explanation. Throughout the drawings, the same letters refer to the same parts.

SCANTLINGS OF THE PRINCIPAL TIMBERS AND IRONS.

Arch pieces, 7 × 14 in., L, six to each truss, or composing each rib.
Pole plate or cap, J, of inner trusses, 10 × 15 in.
Ditto, F, of outer trusses, 10 × 12 in.
Chords, C, of both inner and outer trusses, each in two pieces, each piece 7 × 15 in.
Queen posts, Q, in body, 9 × 10 in.
Ditto, in heads and feet, 10 × 14 in.
Main braces, S, 8 × 10 in.
Counter braces, X, 8 × 4½ in.
Butting pieces, P, at heads of queen posts of outer trusses, 5 × 7 in.
Ditto, T, or straining pieces at heads of queen posts of inner trusses, 5 × 7 in.
Diagonal braces, U, in roof, and under canal truck, 6 × 7 in.
Extra braces, M, on outer trusses only, 6 × 12 in.
Straining sills to ditto, *k*, 6 × 10 in.
Straining pieces to ditto, *f*, 6 × 12 in.
Straining sills to pier posts, *j*, 6 × 10 in.
Fishing pieces to poles, *b*, over piers, 6 × 12 in.
Roof tie beams, E, 7 × 12 in.
Floor girders, G & H, 9 × 18 in.
Additional pieces, A, under girders marked G only, 9 × 15 in.
Plank, of footway, towpath, and canal trunk, thickness 3 in.
Weather boarding, N, thickness ¾ in.
Iron suspending rods, R, 1½ in. diam.
Screw bolts, 1 in. square; spikes for planking of canal trunk, ½ inch square; spikes at heads and feet of braces, ¾ in. square.

In Fig. 1 it will be seen that the tops of the lower girders are not all in the same horizontal line, but that every other one, H, is raised about one foot above the intermediate ones, G. When the aqueduct was first built, only one of these sets of girders was employed, being supposed sufficient to sustain the weight of water in the trunk. Their distance apart was about ten feet in the clear. But when the water was let into the trunk, the girders began to yield under a head of about three feet, and it was found necessary to double their number, and moreover to bolt, or rather stirrup, to every alternate one, viz. those marked G, an additional under-girder, A, Figs. 2, 3, and 4.

The reason for thus alternately raising and depressing these lower girders was, to permit the passage of the two courses of lower diagonal braces from one H to another, over G, (see Fig. 9, and also the dotted lines *a*, *a*, *a*, in Fig. 3). Where the H's cross the inner chords, (which are lower than the outer ones,) they are made to bear on them, by means of the blocks *h*, *h*, Fig. 3. These blocks are not shown in the transverse section, it being supposed to be taken near one of the girders, G. Over the girders, G, are seen (Fig. 3,) blocks O, O, marked in dotted lines; there are transverse timbers, resting on G, and helping to support the flooring plank of the canal trunk, as there are no longitudinal joists in the aqueduct. The pieces O, do not interfere with the diagonal braces, merely running from each inner chord to the braces.

The floor of the trunk rests only on the upper course of diagonal braces, on the transverse pieces, O, and on the raised girders H.

Each girder, H and G, is sustained by the two inner chords, and by four suspending rods of iron, 1½ in. in diameter, of which two are shown in Fig. 4, by R, R. In the outer trusses, the tops of these rods bear on the tops of the arches, or curved ribs, (see Fig. 1,) by means of wooden saddle pieces, D, Figs. 3 and 4. In the inner trusses, they bear upon the tops of the poles, or caps, and are covered by a longitudinal capping piece, of 3 in. thickness (*m*, Fig. 4); this capping is rounded off at top, so as to prevent the chafing of the tow-rope.

To bring the bearing of the suspending rods more equally on all the arch-pieces, blocks are inserted between the arch-pieces, vertically, at the place of each rod, as shown in Fig. 3. M, M, in Fig. 1, are extra braces, employed only in the outer trusses; *k*, *k*, are their straining sills. At their upper ends they abut against short pieces of 6 × 12 (*f*, *f*,) firmly bolted to the poles. These extra braces are in pairs, being on both sides of the poles.

j, *j*, Fig. 1, are the straining sills for the pier braces, S, S, serving to stiffen the pier posts; see Fig. 6, which also shows the cast iron abutment plates, *g*, *g*, for receiving the feet of the curved ribs. They are merely flat plates, 3 ft. 8 in. deep, 2 ft. wide, 2 in. thick, and without any flaunches. The recess in the pieces, for receiving the feet of the ribs, and pier posts, is but eight inches deep. See also Fig. 2.

P, Figs. 3 and 4 are the short butting-pieces for relieving the heads of the queen posts from the action of the main braces. In the inner trusses, instead of these short butting-pieces, long straining-pieces, reaching from one post to another, are used, T, Figs. 3 and 4. T is represented in Fig. 3, to save the trouble of another engraving.

The suspending rods are about 5 feet apart; but it is seen in Fig. 1 that these rods stop short within some fifteen feet of the piers, because the curve of the ribs in that interval would not allow of the passage of girders past them. In this interval, therefore, the ends of the girders are supported by pieces, K, Fig. 7, bolted to the ribs.

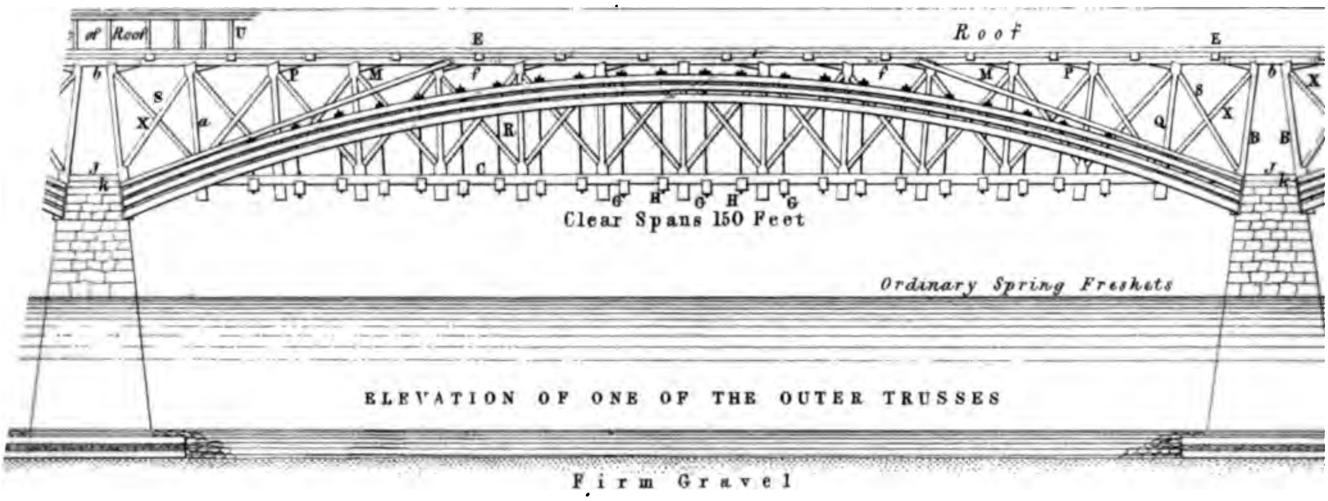
s, *s*, Figs. 2 and 4, are uprights, placed 4 ft. apart, for spiking the side planking of the canal trunk to; at their heads they tenon into a continuous cap-piece, *v*, and at their feet they tenon between the strings *e* and *n*. *n*, and the blocks *t*, being supported by the queens, prevent *s* from spreading outwards.

Where the curve of the arches comes below the line of *t*, the latter is dispensed with, a[illegible] themselves.

r, *r*, are t[illegible] receiving

THE PENNSYLVANIA CANAL AQUEDUCT.

Fig. 1.



ELEVATION OF ONE OF THE OUTER TRUSSES

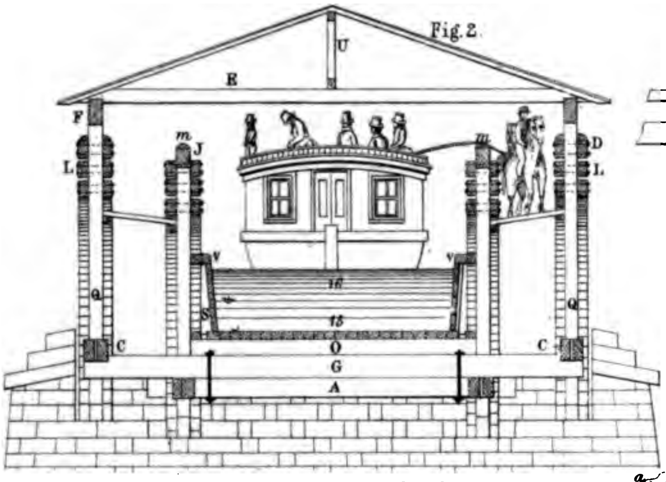
0 10 20 30 40 50 ft.

Scale for Fig. 1.

0 10 15 20 25 ft.

Scale for Fig. 2.

Fig. 2.



TRANSVERSE SECTION OF AQUEDUCT, Taken at centre of a Span.

0 10 15 20 25

Scale for Fig's 3.4.5.6.

Fig. 3.

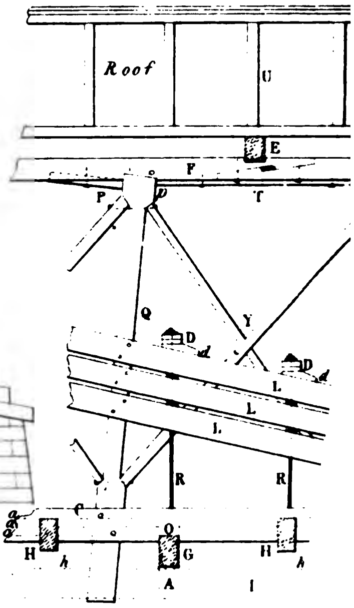


Fig. 4.

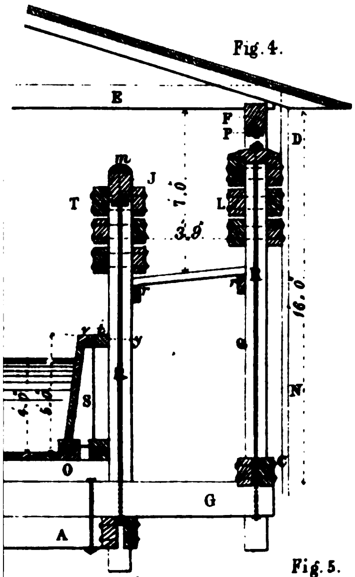


Fig. 5.

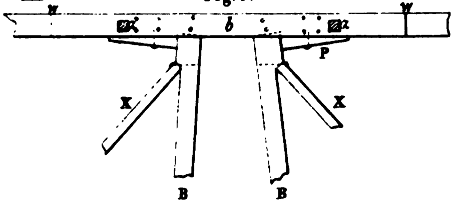


Fig. 7

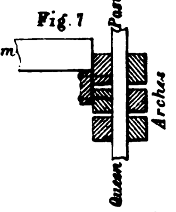
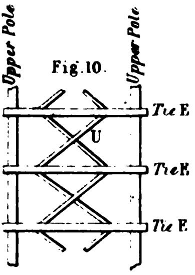


Fig. 10.



Single Diagonal Bracing of Tie Beams

Fig. 9

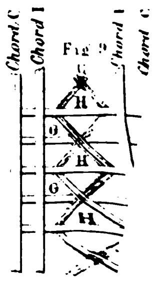


Fig. 6.

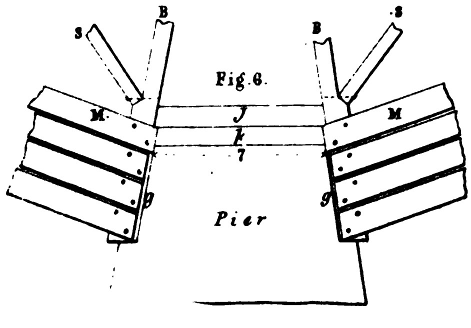


Fig. 8.

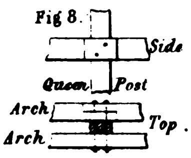
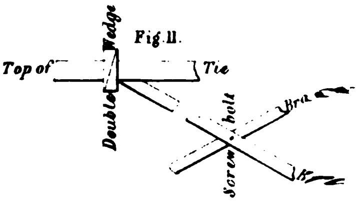


Fig. 11.



the floor plank of the tow-path, on one side, and of the footway for ordinary purposes, on the other.

The roof is boarded and shingled.

Where the tops of the inner arches get below the line of the tow-path floor, a piece of plank on edge resting on the floor is nailed against the queens, to prevent horses from slipping into the canal trunk.

Fig. 5 shows an excellent device for counteracting, to some extent, the tendency which trusses always have to settle in the centre. The poles or caps of the adjoining arches are here connected by fishing splices, each composed of two pieces of 4 × 12 in. well bolted, and trenailed together, through the caps; and as a further security, two blocks, *z*, *z*, of hard wood, about 4 inches square, are driven through from side to side. By the introduction of these splices, it is obvious that the inward draw of two adjoining trusses is mutually counteracted to a considerable extent. This arrangement, together with the extra braces, serves very much to stiffen the trusses, and something of the kind should always be resorted to in large spans.

Fig. 8 shows the mode of scarfing the pieces composing the curved ribs. These pieces break joint where the ribs pass the queens, so that the bolts of the scarfs pass entirely through the queens, and the rib pieces on each side of them. The scarf of the poles is shown in Fig. 3; that of the chords is the same as that of the poles, only that which constitutes the side view of the pole scarf, forms the top, or plan, of that of the chord.

Fig. 11. As it is always a matter of importance in a bridge erected over a stream liable to freshets, to secure each span as soon as possible, so as to stand in case the scaffold should happen to be carried away, the introduction of the secondary timbers is generally deferred until those essential to the support of the bridge, in such an event, are put together. Therefore, the diagonal braces are not inserted until after the girders are put into their places.

As these braces are tenoned into the girders at both ends, they could not be inserted into the mortises in the girders, unless some play were allowed at one end; this play is afterwards filled up by a pair of double wedges, as shown in Fig. 11.

Where the counterbraces of the trusses intersect the main braces, the former are merely tenoned into the latter, as shown in Fig. 3, at Y. Where the chords and queens intersect, they are notched equally into each other, so as to bring the two pieces composing the chords within about an inch of each other, Figs. 2 and 4.

The planking of the canal trunk is single, and well caulked. The courses of plank are from six to fifteen inches wide.

Remarks.—This aqueduct evinces, more strikingly than any other structure I know of, the capability of timber for the purpose of bridge building. The weight of water in the canal trunk on a single span, when 4 ft. 3 in. deep, amounts to 275 tons, of 2240 lb.; and we may safely say that that weight is frequently increased to at least 300 tons, during the passage of boats; for although a boat, of course, displaces a bulk of water of equal weight with herself, yet it may readily be conceived that the water so displaced does not instantaneously leave the span, on her entrance; and I think we may assume that at least 25 tons of it are frequently on a span at the same moment with the boat. Yet on a most critical examination, made with that view, I could not detect in any part of the timbers the slightest symptom of what might with propriety be called crushing. Slight compressions, (if I may be allowed to draw such a distinction,) were visible at the heads of the queen-posts, but not to a greater extent, apparently, than invariably attends all trusses of this kind in common bridges of large spans, after having been some time in use. In all bridges there is a tendency to settle, or sag, in the centre; and this tendency, of course, brings a heavy compressing strain upon the pole plates; but beside this compression, incident to the truss considered as a whole, there is another, acting at the several points at which the heads of the posts tenon into the poles. This compound compression explains a fact for which I was for some time at a loss to assign a satisfactory reason. I have already stated that in the inner trusses of this aqueduct, a straining-piece, like that shown at T, fig. 3, was inserted between the heads of the posts, in preference to the short butting piece, P, figs. 3, 5, employed in the outer trusses. This was evidently done under the impression that it opposed a more perfect resistance to the compressions alluded to, than the shorter pieces; and, at first sight, it will probably strike most of my readers in the same manner. But it is of great importance to know, that although the long piece is almost invariably introduced, both by engineers and bridge builders, whenever extraordinary compression of the pole is anticipated, it is in fact entirely ineffective; whereas the short butting pieces perform the duty assigned them perfectly,

I shall endeavour to point out the cause of this.

The compression of the poles evidently increases from the piers towards the centre of the span, in the same manner as in a single long piece of timber, supported at two ends, when it sags in the middle: consequently, when the bridge settles, as it always will, more or less, the head of any one post is moved a greater distance towards the centre of the span than the post behind it, that is, between it and a pier. Therefore, the opening, p', behind the post, Q′, must be a little wider than the opening p, behind the post Q; and, consequently, the inner end of the straining-piece, T, cannot be forced up into contact with the head of the post Q, but must remain distant from it an amount equal to the difference of the compression which takes place in that part of the pole between Q′ and the centre of the span, and that part which extends from p' to p. This difference in the amount of compression between any two consecutive posts, is very perceptible in all large bridges, being generally about $\frac{1}{8}$ of an inch, that is if there be 7 spaces in the truss, between a pier and a king post, the opening at the inner one will generally be about $\frac{7}{8}$ of an inch, at the next one $\frac{6}{8}$, at the next $\frac{5}{8}$, and so on to the queen post near the pier, where it will diminish to nothing. In some bridges, and those excellent ones, I have seen the openings behind the queen posts much greater than this, at least double; but, I believe, only in such bridges as have no chords to confine the feet of the ribs. Of course some portion of these openings, in every case, is due to the compression which takes place in the heads of the posts themselves. This is frequently very perceptible. I could just detect it in a few of the queen posts of the aqueduct.

But it may be objected that if the explanation I have given be correct, then even the short butting piece, P, should also be ineffective; because, if the compression of the pole increases so perceptibly towards the centre, then supposing the length of the butting piece to be $\frac{1}{4}$ of the distance between two queens, the inner end of the butting piece should not come into contact with the pole, by an amount equal to $\frac{1}{4}$ of the opening which occurs between these two queens. Plausible as this deduction would seem, it is, nevertheless, incorrect, for as I have before remarked, the short butting pieces act admirably, and, as I conceive, for this reason, that although the entire length of that portion of a pole, or cap, between two adjacent posts, is in a state of compression, which, considering the whole truss as one great beam, gradually increases towards the centre, still the action of the main braces against the back part of the head of each post, tends to bring an additional strain upon the portion of the pole next adjoining the inside of the post head. This additional strain produces a compression of its own, which, unlike that operating on the truss considered as a whole, decreases towards the centre. Therefore, that part of the pole into which the head of any post tenons, is more compressed than the part at the end of the butting piece, and, consequently, the latter is brought into full action.

This matter is a very important one, and my remarks on it were suggested by seeing that in this aqueduct the long straining piece had superseded the short butting piece, evidently in expectation of its greater efficiency. In the Market street bridge, at Philadelphia, the finest in existence, the same defect exists; also in the viaduct of the Columbia and Philadelphia Railroad, near Philadelphia, and many others, built by the most talented and experienced bridge builders in the country.

But in all these bridges, as well as in this aqueduct, the inner ends of none of these long straining pieces are in contact with the heads of the adjoining posts, against which they were intended to exert a powerful compression. Consequently, they are not only useless, but positively injurious, as they add unnecessarily to the weight of the truss, and thus absolutely increase that tendency to settle, which they are intended to prevent.

I noticed a splintering, or spalling off, of the stones supporting the feet of some of the arches. The stones in this part of a bridge, as well as those forming the facing of the starlings, should always be of good quality; and, in the former case especially, attention should be paid to their toughness; soft sandstone should never be admitted.

In an extreme case like this, of such an immense weight and so soft a stone, or indeed with stone of the best quality, I should certainly prefer to have the recesses in the top of the pier for receiving the feet of the curved ribs and pier posts, somewhat deeper than in this instance, where they are but 8 in. deep, figs. 1, 2, and 6. The pressure on the piers and abutments, so long as the bridge maintains itself, is almost altogether vertical, and as it sometimes happens that the bearing is not very fair, every precaution should be used to prevent spalling. One of the spans, at the time I saw the aqueduct, was (in my opinion,) in imminent danger of falling, in consequence of this.

I am confident that 2 trusses, instead of 4, would have been sufficient to support the trunk of this aqueduct, especially if another arch-piece had been added to the depth of the curved ribs, and the height of the trusses made a little greater. This additional height would, moreover, have added to the convenience of passengers on the roofs of the boats, who are now obliged to stoop in passing through the aqueduct. As the use of but two trusses would, of course, increase the clear width between them, to admit the tow-path, the girders might be trussed by a heavy arch-piece, which would insure abundant strength. A considerable diminution of expense would attend such an arrangement.

As to the piers of this aqueduct, they are, as before stated, but 7 ft. thick on top, or $\frac{1}{22{\cdot}8}$ part of the span; or not quite ½ as great as the proportion of those used in the Trenton bridge, which is the boldest one cited by Tredgold, in his table of stone piers for wooden bridges.

The foundations of the piers of the aqueduct do not appear to have settled in the least, or to have undergone any derangement; still, even in the face of this precedent, I should certainly prefer the foundation to be laid at the depth of a few feet below the bottom, in structures so important as this. There are, however, several bridges across the Alleghany, in the vicinity of the aqueduct, and all their piers are founded in this manner, (some of them, indeed, having but one course of timbers in their platforms,) which is strong evidence of the sufficiency of the plan, on a gravel bottom, even when exposed to tremendous freshets.

Viewed as a whole, this aqueduct, for which, I am under the impression, there was no precedent, certainly reflects the highest credit on Mr. Lothrop, for boldness and mechanical skill.* There are others, of much the same kind, on the canal; all, I believe, designed by him. The general arrangement of the timbers is not original with him, having been long before practised, in very many instances, in common bridges; but the application of it to the purposes of so extensive an aqueduct, was certainly a very bold step; and its entire success is proof of an intimate knowledge of what he undertook.

I look upon this arrangement of timbers as the best yet devised for large spans. It certainly admits of many improvements in its details, and from some experiments of my own on the subject, I am under the impression that considerable modifications in some of the more important parts, might be made with advantage. I may take occasion, in some future paper, to allude to them.

The curved rib, it is well known, is stronger in the centre than at any other point; or, in other words, a load, which, applied between the centre and one of the piers, would destroy the rib, might be supported, with perfect safety, in its centre. But the truss which is connected with the ribs, is weaker in the centre than at any other point; its resistance to a load acting at any point, being, as in the case of a single piece of timber, proportional to the rectangle of the distances from the point at which the load is applied to the points of support. Therefore, the combination of the curved rib with the truss, secures a more uniform degree of strength throughout the whole span, than could be attained by either one, used separately.

But besides this, another very important consideration attends the combination of the curved rib with the truss, viz: that each not only contributes its own share to the support of the load, but actually increases the power of resistance of the other—that is, the two combined will support a greater load than they could separately, were the load divided between them. A curved rib, when employed by itself, is very weak at the haunches, and readily yields to a load applied there; but if proper means be adopted for preventing the rib from changing its form, its strength is wonderfully increased, indeed to such an extent that actual crushing of the timber must take place before the rib will yield to its load. Without this precaution, its flexibility will permit it to bend, and fall through between its abutments, under a load many times less than that necessary to crush it. Such a change of form, or bending, is prevented by the truss, and thereby so great an accession of strength is imparted to the rib, that if we could conceive the truss acting only in this capacity of a stiffener to the rib, without itself sustaining any portion of the load, still the strength of the bridge would be increased many fold. I have seen curved ribs of 200 ft. span, bend, and fall into the river, between their abutments.

The highest known freshet of the Alleghany, rose to about the floor line of the canal trunk; the weather boarding of the outside formed a kind of dam, against which, trees, barns, houses, &c., accumulated, until they formed a wide field of drift on its upper side. A large concourse of people stood on the banks of the river, expecting to see the whole structure lifted off from its piers, and floated away; but it stood perfectly firm, and I believe sustained no injury whatever.

Engineering Science.—The tunnel on the line of the Sheffield and Manchester Railway will be 3 miles in length, upwards of 600 ft. below the surface or summit of the hill at its greatest height, and in rock formation throughout its entire length. The works were projected and commenced upwards of 2 years ago, under the direction of Charles Vignoles, Esq. Five shafts were opened, at about half a mile distant from each other, for the purpose of proving the formation, of facilitating the driving of the drift-ways, and ultimately, of ventilating the tunnel. Whilst these were in progress, the drift-ways were carried on from each side, or face, of the mountain: the distance, or length, driven, on the eastern side, extending to nearly 1.000 yards, and from the next shaft 180 yards.. The junction between these two portions of the drift-way was effected on the 17th Sept.. and the levels, when checked, on a tie-bench, at the point of meeting, had varied but 9 decimals, or 1 in. nearly, and the range was within less than 2 in. of being geometrically true.—*Weekly Papers.*

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* We think it proper to remark here, that in the 6th volume of the London Repertory of Arts, p. 220, is detailed at length, the specification of a patent taken out in England, in 1796, by Mr. James Jordan, for constructing aqueducts and bridges, with curved ribs of timber, or iron, and suspending therefrom, by iron rods, the floor or trunk, as the case may be. The celebrated bridge over the Delaware, at Trenton, commenced in 1804, is, in its general outline, almost a precise copy of the plate illustrating Jordan's patent, in the Repertory of Arts, and is, in principle, unquestionably an infringement of that patent. Mr. Jordan also gives a plate of a projected aqueduct, precisely the same in its essential principles as that which forms the subject of the above paper.

A FEW OBSERVATIONS ON THE FLY-WHEEL, AND ITS APPLICATION TO THE STEAM ENGINE.

THIS admirable collector and distributer of power, is so important a feature of the steam engine, that too much attention cannot be given to determine the proportion best calculated, to insure a sufficent degree of regularity in its motion, to answer general purposes; it is at the same time equally important to avoid all superfluous weight in its rim, because this imperfection not only creates unnecessary expense in the construction, but also occasions a portion of the effective power of the engine to be sacrificed, to keep the useless mass in motion.

In order to obtain the degree of regularity of motion which is in most cases requisite, the energy of the rim of the fly-wheel must be so proportioned to the power exerted by the piston, as to prevent the constantly varying effect of the power of the steam communicated through the crank, from sensibly affecting the regularity of the motion of the fly-wheel.

The same amount of regularity is not always required, and frequently, steam engines are applied to drive machinery of such a description, as will to a certain extent, equalize the irregular action of the steam through the crank; a corn-mill for instance, requires much less fly-wheel than would be indispensable for a cotton, or flax mill, because the energy of the mill stones, produces the same kind of effect as is produced by the fly-wheel itself, and in some cases, when fly-wheels are directly attached to the machinery driven, they might be made sufficiently powerful to dispense with the engine fly-wheel altogether, in as far as regularity of motion is concerned; but if advantage were taken of this circumstance, very great strain would be thrown upon all the mechanism between the crank and the fly-wheel of the machinery driven, which being frequently considerable, would be rapidly destroyed. A fly-wheel may therefore be considered in most cases indispensable in, or very near the engine-room.

Having had considerable experience in the construction of steam engines, under circumstances which enabled me to establish a regular scale of proportions, between the length of stroke and the relative diameter, speed, and energy of the rim of the fly-wheel, and the following rules having been put to the test of many trials, I am induced to submit this paper for insertion in the *Journal*.

The following table will show the length of stroke, the speed of the piston, the number of double strokes per minute, the diameter, circumference, and speed of the fly-wheel, which I have adopted, and upon which many of the following rules have been established.

TABLE A.

H.P.	Length of Stroke = S.		Speed of piston per minute = W.	Number of dble. strokes of engine per minute.	Diameter of fly-wheel = S × 3·82.	Circumf. of fly-wheel = S × 12.	Speed of the rim of the fly-wheel per sec. $= \frac{W}{10}$
	ft.	in.	ft.	No.	feet	ft.	ft.
2	2	0	150	37·50	7·640	24	15·
4	2	4	157	33·64	8·913	28	15·7
6	2	8	164	30·75	10·186	32	16·4
8	3	0	171	28·50	11·460	36	17·1
10	3	4	178	26·70	12·733	40	17·8
12	3	8	185	25·22	14·006	44	18·5
14	4	0	192	24·00	15·280	48	19·2
16	4	4	199	22·96	16·553	52	19·9
18	4	8	206	22·07	17·826	56	20·6
20	5	0	213	21·30	19·100	60	21·3
25	5	4	220	20·62	20·373	64	22·
30	5	8	225	19·85	21·646	68	22·5
35	6	0	230	19·16	22·920	72	23·
40	6	4	235	18·55	24·193	76	23·5
45	6	8	240	18·00	25·466	80	24·
50	7	0	245	17·50	26·740	84	24·5
60	7	4	248	16·91	28·013	88	24·8
70	7	8	251	16·37	29·286	92	25·1
80	8	0	254	15·87	30·560	96	25·4
90	8	4	257	15·42	31·833	100	25·7
100	8	8	260	15·00	33·106	104	26·

The dimensions and weight of the rim of the fly-wheel, may be determined by the following rules; (note—in the calculation of the energy of fly-wheels, the boss and arms are not taken into consideration, they should be made as light as prudence will permit.)

Rule 1. To determine the mean diameter of the fly-wheel, measured in the middle of the breadth of the rim.

Multiply the length of stroke of the engine by 3·82, *the product will be the diameter of the wheel, measured in the middle of the breadth of the rim.*

The above proportion being adopted, will determine the following relative conditions.

1st. *The rim of the fly-wheel will run* 20 *feet per second, when the piston travels* 3½ *feet per second;* or in other terms,

2nd. *The speed of the rim of the fly-wheel, will be to the speed of the piston as* 6 : 1; (note—this is not mathematically correct, because for the mean speed of the piston to be 1, when the speed of the middle of the rim of the fly-wheel is 6, it would be requisite that the half circumference of the fly-wheel should be 6, when the radius of the crank is 0·5, in which case the circumference of the fly-wheel being 12, the piston for one revolution of the wheel would make a double stroke = 2 feet, or twice the length of stroke, so that when the stroke = 1, the circumference of the wheel should be 12, and its diameter necessarily $\frac{12}{3{\cdot}1416} = 3{\cdot}8197$, &c., which should be the constant multiplier, instead of 3·82 that, with a view of avoiding useless decimals, I have adopted, the difference resulting therefrom being of no practical importance, since the multiplier 3·82 gives 6·0004 to 1 instead of 6 to 1.)

3rd. *The circumference in feet of the fly-wheel, will be equal to the length of stroke of the piston in inches.*

4th. *The speed in feet per second of the middle of the rim, will be exactly one tenth of the speed of the piston in feet per minute.*

Area of cross section of the rim of the fly-wheel. Ten square inches area of cross section of rim, will answer very well when the periphery of the rim of the wheel travels at the rate of 10 feet per second, and could be adopted as a constant area for that speed, if the effective load per H. P. on the piston, was a constant load for every engine; this would be the case if the stroke for every power was the same, but the speed increases with the power of the engine, and the load on the piston varies inversely as the speed, so that the above proportion being determined for an effectual load per H. P. of 155 lb. on the piston, when travelling at the rate of 213 feet per minute, which load and speed are those of a 20 horse engine—then the effective load or the speed at which it travels, must be taken into consideration in the calculation, for, with an uniform load and speed as above determined, the section of the rim in square inches per H. P., would be found by multiplying the square of 10 feet per second, or 100 by 10 square inches, and dividing the product by the square of the true velocity of the rim, the cross section of which is to be found, or in more simple terms, by dividing the constant number 1000, by the square of the true velocity per second, of the rim, the cross section of which is required.

But as the load and speed vary with the power of the engine, it will be requisite to multiply the above quotient by 21·3, the standard velocity of the rim in feet per second, and to divide the product by the true speed in feet per second of the rim, the cross section of which is required, the quotient will be its area in square inches per H. P.

Therefore when V = True speed of the rim in feet per second.

V^2 = Square of ditto.

A = Area of the cross section of the rim in square inches per H. P., we shall have

Formula 1.

$$\frac{10^2 \times 10}{V^2} \times \frac{21{\cdot}3}{V} = \frac{10^2 \times 10 \times 21{\cdot}3}{V^3} = \frac{21300}{V^3} = A,$$ from which results,

Rule 2. To find the area in square inches per H. P. of the section of the rim of a fly wheel, its diameter and velocity being determined by Rule 1.

Divide the constant number 21300 *by the cube of the velocity in feet per second, the quotient will be the area in square inches per* H. P.

Example. What will be the area in square inches per H. P. of the rim of the fly-wheel of a 20 H. E., the velocity of which taken in the middle of the rim is 21·3 feet per second?

$$\text{When } V = 21\cdot 3$$
$$V^3 = 9663\cdot 597$$

then $\frac{21300}{V^3} = \frac{21300}{9663\cdot 597} = 2\cdot 2 =$ area per H. P. in square inches.

For corn mills, saw mills, and other machinery not requiring great regularity of motion, or which by its own peculiar character tends to equalize the effect of the steam, 7 square inches of cross section may be allowed instead of 10, and will be found to answer very well; on such occasions the constant number 21300, will be reduced to $10^2 \times 7 \times 21\cdot 3 = 14910$, and the formula No. 1 would be $\frac{14910}{V^3} = A$ = Area of cross section of rim in square inches per H. P.

The area of the cross section of the rim of the fly-wheel being obtained as above, the total weight of the rim per H. P. will be found by multiplying the area in square inches by the circumference of the wheel in inches; the product will represent the number of cubic inches of metal in the rim per H. P.; and this number divided by 1728, will give the number of cubic feet of metal, which multiplied by 450, (the weight in lb. of a cubic foot of cast iron,) will give the weight of the rim in lb. per H. P.

Therefore when V^3 = cube of velocity of rim of fly-wheel in feet per second, π = circumference of ditto in feet, we shall find

Formula 2.

$\dfrac{\frac{21300}{V^3} \times 12\pi}{1728}\, 450 =$ weight of rim in lb. per H. P., and by reducing the constant numbers to a simple denominator, we shall obtain,

Formula 3.

$\frac{66562\cdot 5}{V^3}\, \pi =$ weight of the rim per H. P. in lb. For corn mills, this constant number would be reduced to 53250, and formula 3 would be $\frac{46593\cdot 8}{V^3}\, \pi =$ weight of the rim in lb. per H. P.

Rule 3. To find the weight in lb. of the rim of a fly-wheel, its velocity in feet per second, and circumference in feet, being given by Rule 1st.

Divide the constant number 66562·5 *by the cube of the velocity of the rim of the fly-wheel in feet per second, and multiply the quotient by the circumference of the rim in feet, measured in the middle of its breadth, the product will be the weight of the rim in lb. per* H. P.

Example. What should be the weight in lb. per H. P. of the rim of a fly-wheel of a 20 H. E., the circumference of the rim being 60 feet, and its speed 21·3 feet per second, (the stroke of the engine being 60 inches)?

$$\text{when } V = 21\cdot 3$$
$$V^3 = 9663\cdot 597$$
$$\pi = 60\cdot$$

then $\frac{66562\cdot 5}{V^3}\, \pi = \frac{66562\cdot 5}{9663\cdot 597} \times 60 = 413\cdot 22 =$ lb. weight of rim per H.P.

By the rule to find the area, the cross section of the rim of the fly-wheel per H. P. would be $2\cdot 2 \times 20 = 44$ square inches, and

By the rule to find the weight, it is shown that the weight of the rim of the fly-wheel of a 20 H. E., would be $413\cdot 22 \times 20 = 8264$ lb.

In formula No. 3, π is the product of the length of stroke in feet, multiplied by $3\cdot 82 \times 3\cdot 1416 = 12$, so that by multiplying the constant number 66562·5 by 12, we shall obtain a new constant number 798750, which will admit of the following construction.

Formula 4.

$\frac{798750}{V^3}\, S =$ lb. weight of the rim per H. P.

In formula 4, S = the length of stroke in feet, this formula gives

Rule 4. To find the weight of the rim of the fly-wheel in lb. per H. P., the length of stroke of the engine, and the velocity of the rim of the fly-wheel, being determined by Rule 1.

Divide the constant number 798750 *by the cube of the velocity of the middle of the rim of the fly-wheel in feet per second, and multiply the quotient by the length of the stroke in feet, the product will be the proper weight of the rim in lb. per* H. P.

Example. What should be the weight in lb. per H. P. of the rim of the fly-wheel of a 20 H. E., the speed of the middle of the rim being 21·3 feet per second, and the length of the stroke 5 feet (see column 2 and 7 of table A)?

$$\text{when } V = 21\cdot 3$$
$$V^3 = 9663\cdot 597$$
$$S = 5\cdot$$

then $\frac{798750}{V^3} S = \frac{798750}{9663\cdot 597}\, 5 = 413\cdot 25 =$ lb. weight of rim per H.P

giving the same result as obtained by formula 3.

For corn mills, &c. the constant number 798750, will be reduced to 559125, so that for such purposes the formula would be

$\frac{559125}{V^3}\, S =$ lb. weight of rim per H.P.

The following table has been constructed according to the foregoing rules, and column 7 has been added for formula 5.

TABLE B.

H. P.	V^3	Area of the cross section of the rim per H.P. = $\frac{21300}{V^3} = a$.	Total area of ditto $a \times$ H.P.	Weight of the rim per H.P. = $\frac{798750}{V^3}$ S	Total weight of the rim	Relative load on piston per H.P. that of a 20 H.E being one represented by $\frac{213}{W} = P$.
		sq. in.	sq. in.	lb.	lb.	
2	3375·	6·31	12·62	473·32	946	1·42
4	3869 893	5·5	22·	481·6	1926	1·356
6	4410·944	4·82	28·97	482·88	2897	1·298
8	5000·211	4·25	34·05	479·22	3833	1·245
10	5639·752	3·77	37·76	472·06	4720	1·196
12	6331·625	3·36	40·35	462·55	5550	1·151
14	7077·888	3·	42·	451·40	6319	1·109
16	7880·399	2·69	43·14	439·18	7026	1·070
18	8741·816	2·43	43·82	426·39	7675	1·034
20	9663·597	2·2	44·	413·25	8265	1·000
25	10648·	2·	50·	400·05	10001	0·968
30	11390·625	1·86	56·	397·35	11920	0·946
35	12167·	1·75	61·25	393·84	13784	0·926
40	12977·875	1·64	65·6	389·75	15590	0·906
45	13824·	1·54	69·3	385·2	17334	0·887
50	14706·125	1·44	72·38	380·17	19008	0·869
60	15252·992	1·39	83·7	383·97	23038	0·858
70	15813·251	1·34	94·23	387·24	27176	0·848
80	16387·064	1·29	103·92	389·92	31193	0·838
90	16974·593	1·25	112·87	392·08	35287	0·828
100	17576·	1·21	121·11	393·81	39381	0·819

The precedent Rules 2, 3, and 4, will suffice when the proportions laid down by Rule 1 are adopted, but will not answer for general purposes; I have given them because, having for several years adhered to the length of stroke, and other dimensions shown in Table A, these rules have answered perfectly so far as the regulation of the motion of the engine itself is concerned, when exerting her full power.

The following Rules 5, 6, and 7, may be employed in all cases for the same purpose, let the stroke of the engine, the diameter and speed of the wheel be what they may.

Rule 5. To find the weight in lb. per H. P. of the rim of the fly-wheel, the length of stroke, the mean diameter, and speed of the rim of the wheel, and the relative load per H. P. on the piston, (the load of a 20 H. E. being 1,) having been given.

Divide the constant number 37500 by the square of the mean velocity of the rim of the fly-wheel in feet per second, and multiply the quotient by the product of the length of stroke in feet, multiplied by the tabular number P (see col. 7, table B.), (P representing the relative effective load per H. P. *on the piston, that of a* 20 H. E. *being* 1,) *the last product will be the weight of the rim in lb. per* H. P.

Example 1. What will be the weight of the rim of the fly-wheel of a 10 H. E., when the length of the stroke is 4 feet, the diameter of the wheel in the middle of the rim 12 feet, and intended to make $48\frac{1}{4}$ revolutions per minute?

when $V^2 = 928{\cdot}4$
$P = 1{\cdot}196$ (see col. 7, table B.)
$S = 4{\cdot}$

Formula 5.

$$\frac{37500}{V^2} P S = \text{weight of rim in lb. per H.P.}$$

therefore $\frac{37500}{928{\cdot}4}\, 4{\cdot}784 = 193{\cdot}2 =$ weight of rim in lb. per H.P.

Formula 5 is thus composed:

$$\frac{\frac{10^2 \times 10}{V^2} P\, 12\, S}{144}\, 450 = \frac{1000}{V^2} P S \frac{12}{144}\, 450 = \frac{1000}{V^2} P\ 37{\cdot}5\ S = \frac{37500}{V^2} P S = \text{weight of rim in lb. per H.P.}$$

Example 2. What will be the weight of the rim of the fly-wheel of a 10 H. E., its diameter in the middle of the rim being 12·733 feet, and making 26·7 turns per minute, the stroke being $3\frac{1}{2}$ feet.

Observation; this example corresponds with the proportion given by Rule 1, as shown in the precedent table A.

then $V^2 = 316{\cdot}84$
$P = 1{\cdot}196$ (see col. 7, table B)
$S = 3\frac{1}{2}$

therefore $\frac{37500}{V^2} P S = \frac{37500}{316{\cdot}84}\, 3{\cdot}986 = 472 =$ weight of rim in lb. per H.P.

For corn mills the constant number 37500 will be reduced to

$$\frac{\frac{10^2 \times 7}{V^2} P\, 12\, S}{144}\, 450 = \frac{700}{V^2} P\ 37{\cdot}5\ S = \frac{26250}{V^2} P S = \text{weight of rim in lb. per H.P.}$$

Rule 5, requires a series of tabular numbers, representing the relative effective load per H. P. on the piston, the load per H. P. on a 20 H. E. piston being considered as unity—this relative load varies inversely as the speed of the piston, and will be obtained (considering the speed of the piston of the 20 H. E., viz. 213 feet per minute as the standard speed,) by dividing 213 by the effective speed of the piston of the engine to be calculated; the quotient will be the relative value P required: column 7 of table B has been calculated so as to simplify the operation.

Admitting 213 to be generally allowed for the speed of the piston of a 20 H. E. in feet per minute, the calculation may be still further simplified, because a new constant number can be obtained by multiplying the constant number 37500 (given in formula 5) by 213, which would create

Formula 6.

$$\frac{37500}{V^2} S \frac{213}{W} = \frac{37500 \times 213}{V^2 W} S = \frac{7987500}{V^2 W} S = \text{weight of the rim in lb. per H.P.}$$

when $V^2 =$ square of the velocity of the rim in feet per second.
$W =$ speed of the piston in feet per minute of the engine to be calculated.
$S =$ length of the stroke in feet of the engine to be calculated, which gives us,

Rule 6. To determine the weight in lb. per H. P. of the rim of a fly-wheel, its speed in feet per second, the speed of the piston in feet per minute, and the length of stroke in feet being given.

Divide the constant number 7,987,500 by the product of the square of the velocity in feet per second, of the rim of the fly-wheel, multiplied by the speed of the piston in feet per minute, and the quotient multiplied by the length of the stroke in feet, will give the weight in lb. per H. P., *of the rim of the fly-wheel.*

Example. What will be the weight in lb. per H. P. of the rim of a fly-wheel of a 10 H. E., its diameter in the middle of the rim being 12·733 feet, and making 26·7 revolutions per minute, the length of stroke being $3\frac{1}{2}$ feet?

then $V^2 = 316{\cdot}84$
$W = 178{\cdot}$
$S = 3\frac{1}{2}$

therefore $\frac{7{,}987{,}500}{V^2 W} S = \frac{7{,}987{,}500}{56{,}397{\cdot}52}\, 3\frac{1}{2} = 472 =$ weight of rim in lb. per H.P.

For corn mills, &c. the formula would stand thus:

$$\frac{5{,}591{,}250}{V^2 W} S = \text{weight of the rim in lb. per H.P.}$$

the constant number 7,987,500, being reduced to 5,591,250.

To avoid misunderstanding it may be proper to repeat in this place, that Rules 2, 3, and 4, are applicable only when the length of the stroke and diameter of the rim of the fly-wheel, are made to correspond with columns 2 and 5 of table A, according to Rule 1, and when the fly-wheel makes the same number of revolutions as the crank; whereas the Rules 5 and 6 may be made use of on all occasions, be the length of stroke, diameter of the wheel and its speed what they may.

It is occasionally desirable to make use of a fly-wheel, that has not been expressly made for the engine to which it is intended to apply it, and it is then requisite to determine the speed at which the rim should travel to produce the usual effect on the motion of the engine; the following rule will determine that speed; the weight of the rim in lb., and the circumference of the rim in feet being given.

Rule 7. 1*st. Divide the total weight of the rim in lb. by the number of* H.P. *of the engine, the quotient will be the weight of the rim in lb. per* H. P., *divide this weight per* H. P. *by the length of stroke of the engine in feet, and reserve the quotient for a divisor.*

2nd. *Divide the constant number 7,987,500, by the divisor found above, and divide the quotient by the speed of the piston in feet per minute, which will give the square of the velocity of the rim of the fly-wheel in feet per second, and extract the square root thereof for the velocity of the rim in feet per second.*

3rd. *Divide the velocity of the rim in feet per second by the mean circumference of the rim in feet, multiply the quotient by 60, and the product will be the number of revolutions the fly-wheel should make per minute.*

This rule gives

Formula 7.

$$\sqrt{\frac{7{,}987{,}500 \div \left(\frac{\text{total weight of rim in lb.}}{\text{H.P.}} \div \text{length of stroke in ft.}\right)}{\text{speed of piston in feet per minute}}} =$$

$V =$ velocity of the rim of the fly-wheel in feet per second.

and $\frac{V}{\text{circumference of rim in feet}} \times 60 =$ number of revolutions of wheel per minute, or

Formula 8.

$$\sqrt{7{,}987{,}500 \div \left(\frac{\text{total weight of rim in lb.}}{\text{H.P.} \times \text{stroke in feet}} \times \text{speed of piston in feet per minute}\right)} = V, \text{ and } \frac{60\,V}{\text{circumference in feet}} = \text{number of revolutions of wheel per minute.}$$

Example. If a fly-wheel 15 feet in diameter, measured in the middle of the rim, and weighing (the rim only) 5000 lb., is to be applied to a 20 H. E., what number of turns should this wheel make per minute, the length of stroke of the engine being 5 feet, and the speed of the piston 213 feet per minute?

Length of stroke of engine in feet = 5·
Speed of the piston in feet per minute = 213·
Total weight of rim in lb. = 5000·
Mean circumference of the rim in feet = 47·1

Then by formula 8.

$$\sqrt{7{,}987{,}500 \div \left(\frac{5000}{20 \times 5} \times 213\right)} = 27{\cdot}4$$ = speed of the rim in feet per second, and $$\frac{27{\cdot}4 \times 60}{47{\cdot}1} = 34{\cdot}90$$ = nearly 35 revolutions per minute.

For corn-mills, &c., this formula would only vary by reducing the constant number 7987500 as stated above to 5591250.

therefore $$\sqrt{5591250 \div \left(\frac{5000}{20 \times 5} \times 213\right)} = 22{\cdot}9$$ = speed of rim in feet per second, and $$\frac{22{\cdot}9 \times 60}{47{\cdot}1} = 29$$ revolutions per minute.

That is to say, that for machinery requiring regularity, the fly-wheel applied to a 20 H. E. should make 35 revolutions per minute, but if required to drive machinery for which regularity is not necessary, the same wheel need not make more than 29 revolutions per minute.

Formulæ 7 and 8 are obtained by reversing formula 6.

London, October 11th, 1842. H. H. Edwards.

NOTES ON STEAM NAVIGATION.

The management of the furnaces.—It is a common practice in steam vessels to pile the coal much too abundantly on the fire grate, the stratum of incandescent fuel is too thick, and the generation of carbonic oxide is the consequence, to the manifest diminution of calorific effect. The coals should be strewn upon the grate bars evenly and equally; the depth of the stratum should be about three inches, but this is a point dependent in a great measure upon the intensity of the draught; the stronger the draught the thicker should be the stratum of incandescent fuel. The bars should never exceed 7 feet in length, and should be as much less as possible; 5 feet is a good length, and not an uncommon length in the best boilers. It is impossible to fire long furnaces properly, especially in a sea way. We have known the length of the fire bars to be reduced from 8 ft. 6 in. to 5 ft. 6 in. with a great accession to the steam-producing powers of the boiler. The bars should always have a considerable inclination, both to facilitate the transmission of the fuel from their foremost to their aftermost extremity, and to diffuse the air more equably over their lower surface. The skill of firemen varies greatly, and due attention should be paid to their selection. A dead plate at the mouth of the furnace is a good thing, and combined with a slow combustion will obviate smoke and save fuel. These are the true secrets of combustion on chemical principles.

Boilers, wear and tear.—The wear of boilers is not unfrequently chiefly from the outside round the steam chest, from the dripping of water from the decks, in the ash-pits from the wetting of the ashes, and on the bottom of the boiler from the action of the bilge water. This last source of wear is now almost altogether obviated in some of the best steam vessels, by placing the boiler upon an efficient *caulked* platform, bedding it in putty—not an incorporated mass of lime and oil, but really sound substantial putty, such exactly as glaziers use. A cooming of timber is attached to this platform, encircling each boiler, and the interstices between the timber of the cooming and the iron of the boiler are filled in with roman cement, and sloped off on the upper side, so that no water can lie on the cement or cooming. It might be expected that these coomings would be disturbed by the expansion of the boiler when heated, but we find that the expansion is so inappreciable in practice as not to be productive of any visible derangement. The upper parts of boilers should be covered with felt and sheet lead, soldered wherever there is a joining; the practice of covering boilers with felt and sheet lead is now almost universal among the best engineers.

Blow-off cocks are a perpetual source of annoyance if they be not well made at first. The metal of which they are composed should be hard and tough, without any lead in it. The plugs of the cocks, if made with too little taper, will be very apt to jam, and after having been ground a few times, will sink so far into the socket as to come in contact with the bottom, if there be one, and diminish materially the effective area of the water way. If the taper be too little on the other hand, a great strain will be thrown on the gland, which keeps the plug in its place, and if they give way it will be driven out with great force. This did occur in the Great Western, and the engineer was scalded to death.

The durability of brasses is dependent upon a variety of circumstances, but chiefly upon the quantity of rubbing surface and the quality of the metal. We have seen a brass of Boulton & Watt's which had worked for thirty years, and was at the end of that time in good preservation, whilst we have seen other brasses which, in the course of a couple of years, were quite worn out.

De omnibus rebus et quibusdam aliis.—Should the engineers be subject to the captains? In generals, YES—in particulars, NO. The Admiralty regulations in reference to engineers are just as preposterous as might be expected, inasmuch as the Admiralty is invariably a century behind the merchant service, but in their regulations respecting engineers, they have out-Admiraltied themselves and earned a title to a squabash with our tomahawk, with which we may probably honour them on an early occasion. The Admiralty desires to have young men of education as engineers, and yet with Admiralty consistency rates the engineer *beneath* the ship's carpenter—and what engineer of talent and education would place himself in so abject a situation, or submit to be snubbed and brow-beaten by every whiffling lieutenant or embryo midshipman who does not know the garboard streak from the log line? As to your amateur mechanics, we always shun them as carefully as we would do a rabid dog; their bite is dangerous, and their bark—why that of Cerberus was heavenly music to it. We have never recovered from the alarm we once experienced from the spectacle of one of these *cognescenti* with blackened fustians and white kid gloves, crawling daily, for the space of a whole week, through the labyrinths of an oily steam engine, to vindicate his title to engineering proficiency. We bethought ourselves of Nebuchadnezzar, and betook ourselves out of reach of the saliva. When we take upon ourselves the administration of the Admiralty, which, between this and 1942, we may perhaps be prevailed upon to do, our first operation will be to get a leviathan besom constructed to sweep away all such incurables preparatory to placing engineers in their proper position.

Ventilation is a thing greatly neglected in steam vessels, although so many facilities exist for establishing an effectual system. Every vessel should be fitted with one or more fans, or Day's patent Archimedean Screw ventilator, worked by the engine for exhausting the air from the different cabins, gratings being left above the doors and in other suitable places for the admission of fresh air from without. The same mechanism might be made to draw air from the holds and other parts of the ship, so that any bad smell from bilge water, &c. would be entirely obviated. In tropical climates, in particular, no steam vessel of any considerable size ought to be unprovided with a ventilating apparatus.

The rolling of steam vessels in a sea way gives a lateral impulse to several parts of the machinery, which it is often not well calculated to resist, without a considerable jolting. Thus the side levers will, when the vessel rolls heavily, slip in and out upon the main centres, and the shafts will move endways. It is true there are collars to prevent this, and in new engines no great movement of this kind can take place; but the collars are in most cases much too small—they are deficient in rubbing surface, and they consequently wear, in a short time, considerably into the brass, leaving a lateral play upon the journal which admits of no adjustment. To obviate this evil, Messrs.

Maudslays & Co. are in the habit of making their journals with very large fillets in the corners, so as, in fact, to make each end of the journal a short frustrum of a cone. This has the desired effect, but occasions a wasteful expenditure of the oil. Mr. Robert Napier makes his cranks to bear against the flanges of his brasses. This plan obviates the rapid wear, but still leaves any wear that has taken place unsusceptible of re-adjustment. The best plan, it appears to us, would be to make each journal bulge out in the middle, so as to constitute, in fact, a portion of a spheroid, and recess each brass correspondingly. The act of tightening the top screws of the journal would then have the effect of preventing the shafts from moving on end, as well as of preventing them from moving up and down. The outer bearing of the paddle shaft should be always so made as to admit of easy adjustment. A common plummer block with the top constructed for holding tallow, placed upon a good stout carriage bolted to the fore and aft bearers, is, in our judgment, the best arrangement. The plummer block bolts should be so made that they may be dropped down to admit a piece of plate iron between the sole and the carriage at any time the shafts may require re-adjustment. A brass in the upper part of the plummer block at the outer end of the shaft is unnecessary, as there is no upward strain, and the cover bolts should be merely sufficient for holding it on in a sea way. This journal always wears forwards as well as downwards, and the brass should be so made as to admit of the aftermost side being turned before. The sides of the brass should also be thicker than in journals where this action does not exist.

Piston Rods.—The best mode of attaching the piston rod to the cross head is by means of a cone and cutter and gib, and a screw above the cone; this cone should have considerable taper both to obviate any injurious expanding action which a cone of little taper would occasion, and to facilitate the disengagement of the rod when it requires to be taken out. Some of Boulton and Watt's cross heads are made close over the piston rod, except that a little hole is left in the top to admit the introduction of a drift to start the piston rod when it requires to be disengaged. This we think is a very objectionable plan, and we have known it in practice to be productive of the most serious inconvenience; for a small drift will not start a rod on which the taper is not considerable, and which is rusted into its place. The drift may indeed be assisted by a cutter driven into the cutter-hole, and so contrived as to force the rod down instead of keeping it up; but even with this aid we have known the largest drift that could be introduced through the top hole to be quite ineffectual in starting the rod. It is a bad practice too to make the upper part of the rod that fits in the cross head eye parallel; a blow or two upon this parallel part will stand and swell it so as to rivet the rod into the socket.

Iron Ships have been much cried up of late by iron ship builders. We admit their claims to favourable consideration, but at the same time maintain that they are attended by many serious disadvantages. In the first place the accumulation of sea weeds and barnacles is a formidable objection. We have seen indeed a scheme of a scraper for removing these accumulations whilst the vessel was under weigh, but it is in our mind puerile and impracticable. Again, the iron of which vessels is composed has been found to become brittle in the course of years, so that although tough at first, it will in the course of time star like glass when struck by a hard and sharp body. The action appears analagous to that which takes place in railway axles. Mr. Nasmyth, indeed, has shown that railway axles are rendered brittle by cold hammering, and may be toughened again by annealing; but he has not shown that axles are not rendered brittle also by continued wear, or that this species of brittleness admits of the same remedy.

Bilge Pipes are best of lead, both because lead resists the action of the bilge water better than any other metal and because it is much cheaper than copper. But the blow off pipes should never be of lead; lead blow off pipes bulge and burst from the continued heat and fragrance to which they are subjected. We find that Mr. P. Taylor at the Institution of Civil Engineers, a short time ago recommended all the pipes exposed to the action of the bilge water in any measure to be of lead, and his recommendation was allowed to pass without comment. We therefore think it expedient to say that we altogether differ from Mr. Taylor in this particular. Neither the blow off or deck pump pipes should ever be of lead though they are always more or less exposed to the action of the bilge water. No engineer in this country ever thinks of making blow off deck pump, or injection, pipes of anything but copper.

Waste Steam Pipe should be as high as the funnel, especially if situated before the funnel. When the waste steam pipe is shorter than the funnel, the action of the steam on the iron of the funnel rapidly oxidizes it and speedily makes the funnel very thin in that part of the ascent to the mouth of the waste steam pipe. When the pipe is made as taunt as the funnel the steam is carried clear of the funnel altogether.

Stop valves between the boilers should be permitted always to act of their own accord, and should never be opened and kept open by drawing up the spindle and keeping it up. Unless the stop valves be allowed to act spontaneously like the safety valves, they will soon become so fixed by corrosion that they cannot be shut at all, and are consequently of no avail. If the increased pressure incident to the weight of the valve be objected to, that weight may easily be balanced by a weight and lever attached to the spindle, where it emerges from the stuffing box of the valve box cover.

Rudder. It is a judicious practice to make the rudder rather shorter than is requisite to reach the keel—the rudder will thus be unaffected if the vessel takes the ground. The keel should always project a little beyond the rudder joint so as to prevent warps or ropes of any kind from catching in the joint as the vessel passes over them. The rule joint is the best species of joint for a steam packet rudder, and by far the neatest: the rudder head should be round and should fit accurately in the rudder trunk, which of course should be a cylinder.

Paddle box boats of Capt. Smith are we think inconvenient—unsightly and ineligible. It would be greatly preferable to have a dozen boats stowed inside one another like the nests of pill boxes of the apothecary. In a heavy sea the paddle box boats could not be raised without great difficulty, and when raised could scarcely be approached. Their proximity to the paddle when launched is dangerous, and the waves would fly up through the paddle box in a sea way with great force, and cut off all communication between the boat and the ship. We regret that Capt. Smith has not found a better vehicle for his ingenuity than this cumbrous, ineffectual and unsailor-like contrivance.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XLII.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. Mr. G. R. Lewis' notions in regard to "intelligence of design" and symbolical expression in ecclesiastical architecture, are too transcendental, not to say, whimsical, to be adopted by our modern church builders, and perhaps it is well that such is the case, since the fanciful mysticism which he recommends might lead to conceits that had better be avoided, ambiguous at the best, and occasionally susceptible of very sinister interpretations. A very great deal of symbolical meaning, whether intended or not, shows itself, for instance, in the design of Bernini's celebrated bronze baldachino in St. Peter's, although critics who look no further than their noses have never detected it. Many of them have reproached the artist for his bad taste in making the shafts of the columns *twisted*, and as far as mere external form goes, they are right; but then they quite overlook the mystic meaning couched under that form. Those columns wind themselves in folds like so many huge serpents, rearing their heads aloft, and thereby typify, in the most expressive manner, both the *serpent-like* *subtlety* and the *crooked policy* of the Romish church. This instance, however, is not even alluded to by Mr. Lewis; so far from giving modern architects and artists credit for any ideas half so ingenious, he complains that they have not only abandoned all "intelligence of design," but more or less *paganized* our churches, and made them compounds of "classical heathenism." In his horror of heathenism he is, in fact, a second Welby Pugin, and perhaps the more consistent writer of the two. Yes, he is consistent and he is honest, which, as the world goes, are two especially rare merits, although his honesty is not of a kind at all likely to recommend him, because he blurts out sundry highly disagreeable remarks against many of our architectural idols—"time-hallowed" and "book-hallowed" structures, for which our implicit and uninquiring admiration is claimed as matter of course, or rather as matter of faith. So far from sparing the "wonderful" Sir Christopher Wren, Mr. Lewis treats that "illustrious architect" very cavalierly indeed, calling him, in all but direct terms, an ignoramus and a bungler; for which he will, no doubt, now get a sound drubbing from Professor Cockerell. But it is not merely particular buildings or architects that Mr. Lewis attacks, he goes much further, and loudly reprobates the whole of the present system of our architectural doctrine and taste, urging us to "shake off the trumpery trammels that have been placed upon us by unnatural education"! This is, indeed, startling, and most awfully so! What is, in such case, to become of such venerable authorities as the great Vitruvius and the great Palladio?—what of the Professors who look up to them for inspiration? The former would be damned, the others "unfrocked." Neither is this all; for Mr. Lewis is such an ultra-reformer, and so obstinately consistent that he is not disposed to tolerate heathenism in our literary education. The man is so blind that he does not perceive how highly proper it is that our youth should be early initiated into the mysteries of heathen mythology, become familiar with the lewd amours of Jupiter and the other Olympian scoundrels; or with revolting and unutterable impurities in the classic poets, which elder school-boys translate for the edification of their juniors. He is for tolerating nothing of the kind; on the contrary, he would fain cleanse the Augean stable of classical art, and ruthlessly despoil our galleries of their most valued treasures,—even of such innocent subjects as combats between Centaurs and Lapithæ, and Greeks and Amazons. With reference to these, "Who would suppose," he asks, "that such disgraceful acts should be considered as fit and proper subjects of study for our youth in this Christian country? Is the act of one man chopping down another worthy of imitation, or the monstrous brute in human form running his sword through the body of an Amazon an idea sufficiently refined to place before our youth—for their improvement? Perhaps we shall be told, that as they have been considered by committees of art to be most exalted works, that they are perfection, and therefore placed in the Museum and National Gallery, that the public may learn how to admire acts of cruelty, and our youth to become skilled in murderous and artificial attitudes, that they may be enabled to produce such sublime and beautiful works as will tend to the enlightenment of the irreligious and immoral. Such are some of the absurdities that are established for the improvement of the rising generation. Need we wonder, then, at our inability to produce original designs? Can it be otherwise? Certainly it will not be while Pagan, Greek, and Roman works of art are to be considered the foundation on which our youth are to be instructed. No style should be held up for imitation, however sublime it may be. Every work of art should be purely an invention; and whether it is to be a church or a picture, the designs for either should arise out of the subject." This will serve as a specimen, though but a mere specimen, of Mr. Lewis' doctrine—singular, perhaps offensive, nor the less so because it is impossible to gainsay it without touching upon very dangerous ground, and attempting formally to defend a very great deal that our convenient hypocrisy now winks at.

II. The "Institute," it may be presumed, are very little aware what a dreadful architectural heretic they have admitted among them as one of their foreign members, in the person of Alexander Bruilov or Brinlov of St. Petersburg. In a letter of his dated from Naples, April 21st, 1825, and published shortly afterwards in a Russian journal, he expresses himself not a little contemptuously in regard to the manner in which architects who go thither for study and improvement occupy themselves in Italy. "It may appear," he says, "exceedingly strange and even absurd to many—more especially to those *fanatics in architecture* who have no notion of, nor care for any thing beyond their compasses and rule—that an architect should employ himself with painting brushes and palette; but without attempting to justify myself, or to point out what does and what does not belong to an architect's studies, I will only say that the more varied they are by being extended to other branches of art, the more likely are architects to become *artists*, and to give evidence of being such, in their immediate profession. Therefore, although I am very far from reckoning myself among those who are gifted with a variety of talents, I do not scruple to take up with other pursuits besides those which more directly belong to me as an architect. Is it not far better, in fact, to occupy one's-self with what will improve one's taste and imagination, than to pore over a shapeless mass of stones and rubbish, idly conjecturing to what edifice they once belonged, or as idly pronouncing what such edifice originally was?—yet, after such fashion it is that many of those who visit Italy pursue their architectural studies. I do not, however, go so far as some do, and say that the architect can learn nothing in Italy that he might not equally well do at home, but I will say, that if, after wandering through the Vatican, and among the temples and other ruins of ancient Rome, an architect does not feel that he has caught something like inspiration from them—does not feel elevated by the idea that he also is called to be an artist—the only, at least the best thing he can do, is to fling away his compasses, and betake himself to any other calling." How far Bruilov himself deserves to rank as an artist in his profession, I am unable to say, nor does Nagler afford me any assistance, for he merely mentions a single work of his, viz., the new Observatory at St. Petersburg; it may therefore be a welcome though small addition to that meagre piece of information to state that among other buildings by him are the following ones: The Mikhailovsky Theatre, opened in 1838; the Lutheran Church, St. Petersburg (Gothic); several of the apartments in the new Winter Palace; and a Gothic Church at Pargalova.

III. A writer upon architectural subjects in the *Spectator*, who, upon the whole, exhibits both cleverness and smartness, is occasionally sadly at fault, and most assuredly so when he expresses somewhat like surprise that bow windows should not be thrown out "in front of almost every London dwelling." No doubt a bow window is very agreeable in a room, but then it is so only so long as it is a *privilege*. Were every house in a street to have such windows, instead of being able "to see up and down the street," people would only see that their neighbour's bows on each side of them were very great bores—positive nuisances, not only as intercepting their prospect, but destroying their privacy, rendering it impossible for them to pass to and fro that part of the room without being subjected to the impertinent gaze of the "people at the next door." A single bow-fronted house in a spacious street or square may be a luxury to the fortunate occupier of it; neither would there be much inconvenience attending the making a bow to every house, provided every house had a frontage equal to that of the National Gallery; but for our scanty and narrow-fronted London houses, they are out of the question. A series of bows would cut up the side of a street into a series of awkward projections, separated from each other only by narrow strips of flat wall. So far, therefore, our street architecture would not be at all improved. In fact, unless a "bow" be of such extent as to be, not a mere feature in it, but a portion of the entire front, it would be exceedingly difficult to make any thing tolerable of it externally, in either the Grecian or Italian style. After all, too, the sitting at a window merely to look up and down the street is very melancholy work.

A congress of architects at Leipsic—the first assemblage of artists ever held in Germany—met on the 14th Sept., to the number of 547, nine of whom were Englishmen. The town of Bamberg, in Bavaria, has been fixed on as the place of their meeting next year.

ON THE DEVELOPMENT OF THE SEMI-ARCH WITH THE FUTURE ADVANCEMENT OF ARCHITECTURAL ART.

By ROBERT CAREY LONG, Architect, Baltimore, Maryland.

In an article which appeared in the Franklin Journal some months back, we attempted to show that the charge of degeneracy was laid against modern architecture, and that this charge could be sustained, inasmuch as in architecture the law of imitation was substituted for that of originalities, the copying of the external forms of the architectural remains of the past for living principles of composition, so that now instead of an architectural work being an organized body, where the external features were the natural result of its internal arrangements and uses, it was, in fact, a mere mass, the parts of which were held together by the arbitrary laws of external form.

We took occasion to say, that the merely changing the style, or fashion of architecture, would in no way effect its regeneration, for, as long as we follow the law of imitation, it makes little difference whether Grecian or Gothic be our model—and yet, we cannot but think the art capable of being roused from its present prostrate condition. For although its forms lie shattered and almost in decay, yet there are living principles of construction from which these very forms have originated, which, if properly understood, and infused into these apparently dead elements, would effect a reorganization, and architecture would once more exist, in newness of life, and perfectness of beauty.

In this all architectural critics agree. No one who knows anything of the subject but admits, that, ever since the downfall of the gothic, architectural art has been in an unprecedented state of degeneracy, that not only has no new architectural style been formed, but not a single element of construction, wall, column, arch or buttress has been developed beyond the condition in which the 15th century left it.

Deplorable as this condition is, it is not yet hopeless. We may even discern in the fact of the growing dissatisfaction manifested towards almost all the modern specimens of architectural design, the dawn of a better era. When the architect looks back into the past, and reflects upon the progress of architecture in all time, observes the sublimity of its forms, and the stately solemnity of its measured footsteps among the Egyptians—sees its aspect of grace, proportion, delicacy, and consummate beauty among the Greeks—notices, among the Romans, the change that takes place in its forms and expressions, its massive piers, its overhanging domes, the triumphal arches, and the fantastic and luxuriant character of its decorations, mingling like the stern battle cry, and the shouts of victory and dominion with the dulcet notes of love and revelry—when he observes also, how this architectural system is broken up before its discordant elements have formed themselves into a consistent whole, now, while a constant struggle is still going on amongst them, the Roman empire falls, and from its fragments new nations arise, and a new architecture comes forth, built as it were upon the wrecks of the *whole of the past*, rising heavenward, and like an organ symphony, combining majesty with grace, solemnity with fancy, with a dim mysterious connecting melody running through all its changes. When he again beholds how even this form of art endureth not, but changes, and as the master spirit abandons the keys of the instrument, (to continue the simile), sees fancy overpowering dignity, harmony becoming wild and rapid, till at length the connecting melody is lost and universal discord reigns supreme; when the architect views all this, can he help feeling that his individual genius can do but little in his art, that the *spirit of the age* must be manifested in its architecture, and that he must be inevitably overruled in his efforts towards a regeneration of the art, unless the community can be made to understand and feel this state of degeneracy, so as to call for and second any movement that shall be made towards the formation of a style of architecture *peculiar*, characteristic of the age, suited to its wants, its desires, its demands.

Since it is the sincere wish of every lover of architecture to see this art leave the trammels in which, at present, it seems bound hand and foot, and take once more that rank among the arts of design which it held among the Egyptians, the Greeks, and the architects of the early Christian church, it becomes all such to look around and endeavour to discover some means of effectuating this important result.

It is granted by all who know anything of the subject, that architecture is not now even what it was during the development of any particular style, that the law of *imitation* instead of *originality* having become the rule of design, *precedent* must be quoted for every individual feature, in short, that the architect is bound down to a *pattern* —a *style;* and that the best he is expected to do is to produce something similar to what has been produced, only sufficiently common and cheap to be built at the present day, all departures from this pattern being considered necessary or accidental faults.

None can feel so deeply this degraded state of this art as the professor of it, when called upon for a design for a building, to be consecrated to the service of his country, or of his religion. Wherefore, he says within himself, should I study the principles of architectural construction? Wherefore should I know that no beauty can be produced without truth of design? Wherefore should I feel all this love of the beautiful in my art, this perception of its capacity for perpetual rejuvenescence and perfection, if I am still obliged to grope on and produce something so far, so very far, behind all that has been done in the days that are gone?

Yet what can be done? Can the architect be before the age in which he lives? Can he do anything to counteract the law, that the peculiar genius of every people must be impressed on their architectural works? How little evidence of individual genius is ever presented in architecture! Look at all the great works of the past; no feature in any style but must have had a beginning, and that too in the mind of man, and yet style after style has arisen and departed, without bearing witness to the genius, or perpetuating the name of the individual minds producing it.

Though these reflections are chilling to the heart of one who is an ambitious struggler after perfection in his art, they should not yet paralyze all endeavour after progress, for, although the architect cannot be in advance of his age, he can at least diligently observe and faithfully interpret its tendencies. To that which in the community already exists as a feeling, he can give a body in thought, and make visible to the senses in form.

Now who has not observed in this day not only a growing dissatisfaction towards all the productions of modern architecture, but also a spirit of hope, a desire after progression and improvement. Let the architect make his building Greek in all its parts and proportions, objection at once is made that it wants originality, or that it is not equal in ornament or richness to the model from which it is copied. If he should choose the Gothic as the mould in which his ideas are to be cast, his production is laid side by side with a magnificent old cathedral, on whose construction and decoration were lavished the wealth of a monarch, the piety of a whole people, the genius of almost inspired artists, and in the consummation and perfecting of which, the most powerful hierarchy that the world ever knew spent century after century. What comparison can be drawn between the meagre production of a single brain, and the manifestations of the maturely developed combination of such elements of greatness? But let the architect be so unfortunate as to design a building in what is called the Roman style, that absurd conglomeration of arches, pediments, columns, piers and pedestals, domes and porticos, and, although he may cite a precedent for every abomination he may commit, though he may by line and rule perpetrate the greatest violations of every principle of truth and beauty, and cry out to every objection raised, that his design is *Roman* and must be judged by Roman law, the day is past that the declaration can avail him anything; he too must be brought before the bar of universal criticism, and be made to answer before the tribunal of taste.

Now the question is, where is improvement to commence, from what point must progression take place? Can the architect invent a new style? What architect ever has done it? Can he even improve on what is already invented? Let him try to alter one jot or tittle the law of Grecian proportion, and witness what a mis-shapen abortion is the result. Let him add but *one* more to the number of the three orders, and order is changed into confusion. Let him attempt to combine the purity and perfectness of the Grecian features of design, with those of any other style of architecture, and he will be made at once to acknowledge that the *beauty* of Greek design depends upon its *purity*, the perfect consistency of all its parts, and their unity of expression. A Grecian building is *one thought*, one full harmony: to catch its expression, it must be unmodulated, unaltered, unalterable. To effectuate this, the architect cannot dare to depart from the known proportions used by the Greeks themselves, until he has discovered the law from which those proportions originate. Until he makes this discovery, the Greek models he must continue to copy, line for line, he must measure every moulding with the most slavish accuracy. Let his design differ in the least particular, the charge of ignorance or presumption may be raised at once against him, and that too, his own good sense will acknowledge with perfect justice.

What too can the modern architect do with the Gothic? Can he improve upon this style as manifested in some of the old cathedrals of the middle ages? As well might he attempt to revive the feudal tenure, to raise another crusade, or re-establish the institution of chivalry. He can do little in the Gothic except to study the wonderful science of its construction, the exquisite beauty and *melody* of its details, the picturesque effect of its arrangements, and beneath the vault of its o'erhanging roof, or looking round at the clustered columns, the glowing windows, and the saintly shrines, bow down in mute wonder at the genius that could project, and the science and skill that could execute such a miracle of beauty.

The utmost perfection to which an architect can now attain in the Gothic style falls immeasurably short of the excellence of the olden time, neither can *we* ever expect to see the day in which such structures as the cathedrals, castles and mansions of the middle ages shall be needed. Modern gothic, or the manner in which Gothic architecture has been latterly revived and applied to the uses of modern times, has brought upon the profession such merited derision and contempt, that we need not fear an universal adoption of this style at the present day, however much it has been denuded and brought down to a *bare-bone* state, to suit the economical display-loving spirit of the age. Still the architect who wishes to bring about a new era in architecture must study the remains of this last great style, in order to see manifested in it, those universal principles of truth which are the tests of the excellence of all styles, principles which are disconnected with that idiosyncracy which constitutes a style, principles by which the architect must be governed in the formation of any new one.

Since, then, Grecian and Gothic architecture as styles exist, in an unimprovable condition, so that perfection in them depends upon accuracy in copying existing forms and details, which copying can never raise architecture from its present state of degeneracy, seeing that this same copying has been tried for 300 years, the architect must now take some other method of resuscitating it. He must infuse some principle of organization into the very elements of its being, the ultimate atoms (if we may so express it), of architecture must be transfused into some medium where they may arrange themselves according to some law of affinity which must exist among them.

Among the different modes of architecture that are at present in use, it appears to us, that there is but one in which an architect, to be great, must use the *principles of its construction only*, without adhering to the details of any model. This is what is called the Roman style, that which is distinguished by the use of the *semi-circular arch* and the *dome*. The people to whom the invention of these modes of building is generally attributed, were prevented, by many reasons, from forming them into an architectural style, notwithstanding the fact of their great capability of being so formed. Possessing little artistic genius themselves, the Romans had the good sense to reverence its manifestations among other nations. They acknowledged the supremacy of Grecian taste, and admitted the unrivalled excellence of Grecian architecture. The Greeks were then their teachers in this art, but unfortunately, at a period when the life and liberty of Grecian art was but a name; the consequence of all this was, that instead of the Roman arch being used as a legitimate architectural feature, bearing the same relation in a building to the part it supports as a Grecian column does to its entablature, it was used as a mere element of construction, or as a fanciful form for an opening in a façade, while in that same façade were placed the horizontal lines of a Grecian entablature, with its own appropriate columns. Thus, two forms of support were used in the same building, to perform the same office, and an architectural pleonasm engendered, whose progeny exists even to this day. That Grecian columns and entablatures could not long preserve their character in such association was soon made evident. The Romans wanted to increase the height of their buildings beyond Grecian proportions, the use of the arch permitted them to build story upon story, and in so doing, every story was accommodated with its own string of entablature, and its own columns. When the story was too high and the space between the arches too small for the due proportion of a Grecian column, by the invention of pedestals, the columns were mounted upon stilts to stretch them out sufficiently, and we thus see Grecian architecture entirely passed away and nothing worthy of the name of a new style substituted in its place, where nevertheless an architecture could have risen, for the germ of a glorious architecture is there.

It seems to have been the peculiar fate of the semi-circular arch, in its different development as a constructive feature, to have failed entirely in creating a distinctive style of architecture, founded upon its use, and characterized by individual features, resulting from its use alone. Not only did this principle of construction fail of a perfect development among the Romans, by whom it was first, as far as we know, extensively used, but at a later period, when, in what is called the Norman style, it seems just arousing itself and coming forth with a freshness and vigor that shows the promise of a new and appropriate style, its progress, by some fatality, was cut short, and all the energy manifested in it turned into a new channel opened by the introduction of the pointed arch. Had this latter never been invented, and had the same genius which produced such a wonderful architecture from this modification of the arch brought its powers to bear upon the semi-circular form of construction, may we not with propriety believe that a style would have arisen out of this latter curve as magnificent and sublime as the Gothic, and when we look at what has been produced in this case, is there not something in the fact to tempt the aspiring architect to study out, and aid the more perfect development of the semi-circular arch.

A style of architecture in which the semi-circular arch shall be used may combine in perfect harmony with every element of construction which has been developed, in all ages past. It may call into use the wall, the column, and the buttress; columns not necessarily Grecian, walls no longer Egyptian, buttresses not of necessity Gothic —a mode of architecture, which, while it may admit the utmost gorgeousness of ornament, expensiveness of material, solidity and durability of construction, with vastness of magnitude, may yet be beautiful in its simplicity, and by the manifest use of all its parts, be satisfactory to the mind which desires *sense*, with utility and unpretendingness—a *unique* mode of architecture, suitable alike for the palace and the cottage, the church and the theatre, the villa and the home of the citizen, the light pavilion of pleasure, and the gloomy portal of a prison—in short an architecture which will take its character from the use to which it is applied, and which can be judged by no rules but those arising from common sense, perfected judgment, and refined taste.

In such a style the arch must have its own place in a building as *the support of the shelter*, and to the shelter, as its appropriate form, must be given the shape of the dome, so as to appear to have, and to have indeed, some relation to that on which it rests. A foundation too must be provided on which the supports shall stand, of some just proportion; the entrances and openings must all be arranged in symmetry with the whole; an architectural beau ideal, in fine, must be formed, for the realization of which we shall search Rome in vain.

In using thus the semi-circular arch, that is, in combining it with other elements of construction, it will be necessary that it should hold the supremacy, and that these other elements should be made subservient there, the wall—the column—the buttress, all can be employed as accessories, and this latter with especial propriety, as having far more use to perform in a building in which the semi-circular arch is used than one in which the pointed arch prevails; for the form of the latter is such that it seems almost fully adapted to dispense with such assistance, and though we would not use Gothic-shaped buttresses and pinnacles with the semi-circular arch, yet why may we not readily use the thing itself, letting peculiar forms arise from its new association and adaptation?

A mode of architecture would thus be formed which would be capable of every variety of use, and which would give scope to the highest flights of genius and originality, borrowing even its decorations from no arbitrary model, but creating them out of the very necessities of the case—an architecture whose primitive form could be traced neither in wicker work, (according to Sir James Hall's theory of the Gothic,) nor in log huts, (according to the Vitruvian account of the Greek orders,) cotemporary tents, like the Chinese style, nor subterranean excavations, the supposed prototype of the Egyptian, but as essentially a creation of the art of building as when that art was best understood. Such an architecture the world has been on the eve of beholding twice, and yet it has never attained to the blessedness of seeing it accomplished; the early Christian before the Gothic style was formed, evincing, as we have just said, a decided tendency to the formation of a perfect style of architecture, on the semi-circular model, and the taste of the age, after the Gothic fell from its "high estate," the age of the reformation, seeking out again the Roman arch, but falling into the error of imitating Roman architecture, as it is called, the architecture of Palladio and others, with all its absurdities, which unfortunately it took for a model, instead of developing still further what previously had been attempted in the Norman style.

The formation of an architecture such as we have here imperfectly sketched out is the work of all succeeding ages, it is what this age is asking for, but without obtaining it, for false taste, the laws of *precedent*, the idea of orders and styles (which never prevailed during the formation of any real architecture) in fact the very reason which prevented the Romans from creating an architecture, out of the very principle of construction we have been considering, still prevail, and are preventing us from producing anything in this art which we can call our own.

The architect who shall be bold enough to commence the innovations necessary as preludes to such a state of art must stand in an imminent deadly breach. He cannot answer the question "In what style is your design?" He cannot call it Roman, for it must violate none of those principles of taste which they who have studied the architecture of all nations—the well-informed—know to be true; it is not Greek; it is not Gothic; it is not Egyptian. The sentence will be "away with it, we know not what it is!"

But should there be found men sufficiently unprejudiced to suffer such a style to be formed, one will arise admitting of all the excellence of Roman construction, Grecian beauty, Gothic grandeur, and Egyptian sublimity, with propriety of plan, purity of design, simplicity and utility in all its details; the days of small things shall have passed away, and *genius* will be no longer considered a supernumerary qualification in an architect.

Baltimore, Maryland,
Aug. 26, 1842.

MEMOIR OF THE LATE JOHN GOLDICUTT, ESQ. F.R.I.B.A., &c.

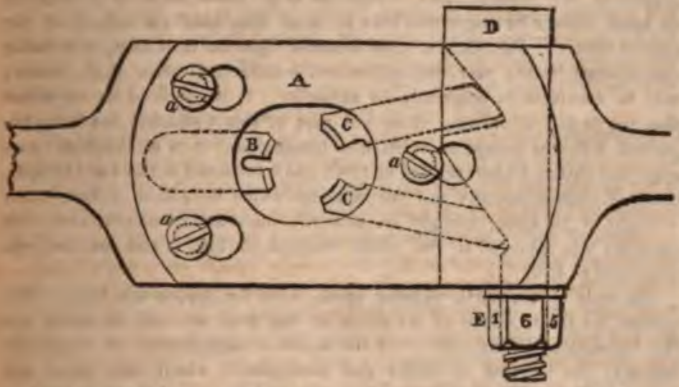
It is with deep regret that we have to announce the decease of John Goldicutt, Esq., architect, of Clarges Street, Piccadilly, who died on the 3rd of October, aged 49. His father was, for many years, the chief cashier and confidential clerk at the banking house of Herries, Farquhar & Co.; and observing in his son an early predilection for drawing, he placed him in the office of the late Mr. Hakewill, who executed considerable works at Rugby School, and built St. Peter's church, Pimlico. Mr. Goldicutt soon acquired considerable skill in drawing, and evinced a happy disposition for colours, a most important branch in the education of the architect. He soon joined an association called the Architectural Students' Society, consisting of young men, who met every fortnight in order to make sketches from given subjects, and thus acquire a facility of design. He on two occasions was a competitor for the silver medal at the Royal Academy, and with this view measured and drew out the façades of the India House and the Mansion House in successive years, and was successful in carrying off the prize for the latter subject. Mr. Goldicutt throughout his life evinced the same ambition of distinction, and on all public occasions was sure to enter the lists in any competition with his professional brethren, which seemed to offer the prospect of a fair and honourable adjudication. After availing himself of the experience to be acquired in the office of Mr. Hakewill, Mr. Goldicutt was sent by his father abroad, and went first to Paris, where he entered the school of Monsieur Achille Leclère, a distinguished pupil of Monsieur Percier, whose reputation he sustained by the brilliant fruits of his studies as Pensioner of the French Academy at Rome. Mr. Goldicutt completed, under this master, his studies as a draughtsman, and regularly competed with his fellow students for the monthly prizes in the Academie des Beaux Arts. He then went to Rome, where he carried out his predilections for decorative architecture by making a rich collection of sketches from the most valuable fragments of the ancient monuments. His most remarkable work, while residing in this capital of the fine arts, was a splendid transverse section of St. Peter's church, which he most elaborately worked up, representing the splendours of that remarkable edifice, with all its sumptuous decoration of gold and colour, and splendid pictures by the first masters. This production, which is the happiest effort at drawing of the English school of architecture, excited so much admiration that he was prevailed upon to submit it to the inspection of the Pope, who presented him with a large gold medallion as a mark of his gracious approval. After an absence of 3 or 4 years, Mr. Goldicutt returned to England, and commenced his professional career of practice as an architect; and soon his refined taste, lively imagination, and facility of drawing, introduced him into considerable private practise, and he severally carried off prizes in competition for the Post Office, for the Lunatic Asylum, and other buildings. Mr. Goldicutt always entertained a most active and generous enthusiasm for his art, and was ever one of the foremost to join in any proposition which he thought would honour it and raise the profession in the estimation of the public. He was one of the original founders of the Royal Institute of British Architects, of which he was one of the first Honorary Secretaries; and in his own house originated the proposal of the Soane testimonial, in carrying out which he devoted much time. The whole arrangements of decorating Freemasons' Hall on the occasion of presenting Sir John Soane with the medal struck in his honour, devolved upon him; and the taste and skill with which he arranged the embellishments, excited the admiration of all present on that venerable night. Mr. Goldicutt was elected Member of the Academy of St. Luke's at Rome, and of the Academy of the Fine Arts at Naples. He was a competitor for the Nelson monument, and sent in a design consisting of a colossal figure of Nelson, standing on an immense globe, which reposed upon a pedestal in the centre of a large basin, which served as a fountain. The novelty of the design excited great attention at the time, but so little prepared is the public mind for any new conception at variance with its old established notions, that exception was taken to the daring project in many of the public criticisms of the day. But we cannot but concur with the remark of a distinguished amateur, who observed to us recently, that if such a design had been executed in Germany to one of her great men, within 50 miles of the banks of the Rhine, there would not be a traveller on the waters of that river who would not have made a point of going to see it.

Mr. Goldicutt and Mr. Gutch were appointed by the vestry of Paddington to carry out a design which they had submitted for the new church now in course of erection in the Grand Junction Road. The style is Gothic, and the accommodation is calculated for 1650 persons, 600 of the sittings being free, and reserved for the poor. He had lived long enough to cover in the body of the church, and had just commenced the steeple, to which he purposed devoting great attention, in order to render it a masterpiece of taste in design and skill in execution; but like the lamented architect of St. Dunstan's new church in Fleet Street, the late Mr. Shaw, his fate was not to live to see the completion of a work in which he took the most intense interest up to the moment of his decease. In fact, there never was an architect who felt a more generous and devoted enthusiasm for his art, as all his feelings were sure to be absorbed in any interesting subject which presented itself in connexion with architecture; and if he had a drawing in hand, the midnight hour and the earliest dawn of the morning found him unremitting in his application, until he had completed the pleasing task. His knowledge of the works of the ancients and moderns was extensive, and he was so feelingly alive to proportion of parts and the effects of light and shade, and of contrast and harmony in colour, that he was continually studying the different parts of his buildings up to the moment of their completion, not being satisfied until he had tried every modification which could tend to improve them. Mr. Goldicutt published some views in Rome, and a series of etchings of views in Italy and Sicily. He was the author of an elegant work on the paintings in the Pompeian buildings, and of an interesting small volume in illustration of Heriot's Hospital at Edinburgh, the plates of which he etched himself.

He has left a widow and 5 sons to lament his irreparable loss, and lies buried in the New Cemetery at Kensal Green. The death of such an artist is a loss to his family, to his friends, and the public. Mr. Goldicutt was Surveyor for the District of St. Clement's Danes, and St. Mary le Strand, and one of the Justices and Commissioners of Sewers for Westminster and Middlesex.

PATENT GUIDE SCREW STOCK,

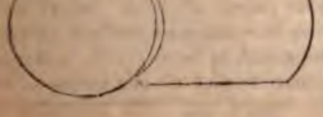
Manufactured by Joseph Whitworth & Co. *of Manchester.*



A. the top plate, fastened by screws, *a, a, a*. B, a stationary die. C, C, moving dies. D, a sliding piece with inclined sides for moving the dies. E, a nut for drawing up the piece D.

The guide stock is entirely new in principle, and will cut a screw scarcely inferior to that obtained in a slide lathe from a true guide. The name has been chosen from this circumstance, as expressing the peculiar feature of the invention. The thread produced is not only true and of the exact pitch required, but perfectly formed throughout, being cut clean without distortion of the metal.

In all these respects the advantage of the guide over the common stock is remarkable. The latter, it is well known, will not cut a screw in any degree perfect. The thread, besides being irregular, is never of the right pitch. It is also more or less swollen by the violence done to the metal, so that the diameter of the screw is often considerably greater than that of the blank shaft on which it is cut. These defects are attended with the most serious practical inconvenience. They often render it extremely difficult to obtain a fit between the screw and nut, and consequently occasion a considerable sacrifice of time and labour. They necessarily impair, in a very great degree, the efficiency of the screw bolt, which cannot possess either the strength or mechanical power which it would have if the thread were cut true and clean. The defects in question are variously modified according to the size of the master tap used in cutting the dies. If they have been cut by a master tap double the depth of the thread larger in diameter than the shaft to be screwed, they will act very well at first, and the thread will be started true; but as the operation proceeds, they become altogether unsteady and uncertain in their action. If, on the other hand, they have been cut by a master tap of the same size as the shaft to be screwed, the thread is made untrue in its origin. They first touch the shaft only on the extreme points of their outer edges, as shown in the annexed sketch. They have neither sufficient guide, nor steady abutment, till the operation is on the point of being completed. It is not unusual to employ a master tap of an intermediate size. In this case, however, it is obvious, the dies will combine, in a modified degree, the defects peculiar to each of the cases before mentioned.



In the guide stock this perplexity is entirely obviated, and the dies act with full advantage from the commencement of the operation to its conclusion. They are cut by a master tap double the depth of the thread larger in diameter than the screw blank; while their general form, and the direction in which they are moved forward, are such as to preserve their cutting power and steadiness of action undiminished to the full depth of the thread.

The plan of the guide stock will be easily understood from the sketch prefixed. The interior of the stock is shown in dotted lines through the top plate A. B is a stationary die; C C are moving dies, brought up by a piece D, sliding in a recess in the stock, and bearing with a distinct incline against the back of each die. The piece D is drawn up by a nut E, on the outside of the stock.

The dies having been cut by a full-sized master tap, as before mentioned, the curve made by their outer edges is that of the blank shaft they are intended to screw. Hence in starting the thread, they bear at all points of the common curve, and the impression made by indentation is the exact copy of the thread of the die. The parts indented serve as a steady guide to the dies in cutting round the blank shaft. A groove in the stationary die facilitates the operation. Four cutting edges are brought into action at points of the circumference nearly equidistant, so that by little more than a quarter turn the thread is completely started round the shaft. The difficulty involved in the operation by the common stock is entirely removed.

After starting the thread, the stationary die serves principally as a guide and abutment for the others. The moving dies are peculiar in their form and direction, both peculiarities depending on the position of the arc in the shank of the die. The two sides have each a different inclination to the arc. As the dies move forward, one side becomes prominent towards the screw shaft, and its cutting edge continues in contact with the thread, till it is formed to the full depth required. The prominent sides of the moving dies are those turned towards each other.

The direction of the common die is necessarily towards the axis of the screw shaft. In the guide stock the direction of the moving dies is that of two planes, meeting beyond the centre of the stock, in a line parallel to the axis of the screw shaft, and considerably behind it. This direction is determined by reference to the change which takes place in the relative position of the screw shaft, as the thread is cut deeper. One of the three dies being stationary, there must necessarily be a constant change in the position of the screw shaft in relation to the two others, the effect of which, if not counteracted, would be to deprive the cutting edges of the requisite prominence. By giving them the direction before mentioned, the proper degree of prominence is secured, notwithstanding the change of position. The latter, when combined with the eccentricity of the dies, so far from being any impediment to their action, materially assists it. The newly formed thread is thereby kept in contact with the dies for some distance behind their cutting edges, affording them the same kind of support throughout the operation which they have at its commencement, when, as before observed, the curve made by their outer edges is coincident with that of the screw blank. This continued support, which is necessary to steady their action, could not be obtained without a change in the position of the screw shaft. They would otherwise acquire too much clearance, as they form the thread deeper, and their cutting edges would be apt to dig.

The steadiness of the guide stock, and its easy action in screwing, are equally remarkable. In using it, not one half the force consumed by the common stock is required. The inner edges of the moving dies (which principally act in cutting out the metal,) are filed off to an acute angle. This enables them to cut with extreme ease, and without in any degree distorting the thread, while they take off shavings similar to those cut in a lathe. Their action in cutting is in effect the same as that of a chasing tool, to which they bear an obvious resemblance in form. They may also be sharpened on a grindstone in the same manner.

A practical difficulty has hitherto attended the use of the screw stock, arising from the wear of the taps and dies. The tap becomes less in diameter and consequently taps the hole too small, while the opposite effect takes place with the dies, which, being unable to cut a full-sized thread, leave the screw too large. The only mode of counteracting this two-fold error, so as to obtain a fit between the screw and nut, is by forcing the dies forward, till they have reduced the diameter of the screw a proportionate quantity. From what has been before observed, it is evident that this cannot be done in the case of common dies without injury to the thread. In using the guide stock, on the contrary, it is attended with no disadvantage. Lest the diameter of [illegible] necessary. figures are [illegible] when the thread is full.

[illegible] CATHEDRAL.

[illegible] at *Hereford, and on the causes* [illegible] M.A. F.R.S., of Caius College, [illegible] in that University.

([illegible] Plates [illegible] and [illegible])

[illegible] settlements and consequent distortions [illegible] generally the case with buildings of the [illegible] the choir inclines considerably to the [illegible] Lady Chapel to the south; the walls of the [illegible] and outwards in all directions, and the [illegible] are also thrust northwards. The north porch, [illegible] Booth, is also considerably inclined to the [illegible] to the west; in short there is scarcely a [illegible] building, with the exception perhaps of the [illegible]

[illegible] settlements are carefully examined, they appear to be [illegible] more from compression of the ground or [illegible] stand, than from weakness of the walls themselves [illegible] piers are not bent into a convex form, as they [illegible] given way from constructive weakness, but are thrust [illegible] the ground on the yielding side. This may, for [illegible] the piers of the nave, near the great tower, both on [illegible]

[illegible] these settlements however, can be shown to be of [illegible] as might be expected, taken place very soon after the [illegible] and there is no fear of their going any further, except [illegible] which the original settlements may have so weakened the [illegible] and displacing their materials as to allow them to sink [illegible] weight or that of the subsequent additions.

[illegible] of examining the nature of the foundations, excavations [illegible] by Mr. Cottingham, at the bases of the piers on the south [illegible] nave, and about that of the northern piers of the tower. From [illegible] as well as from an excavation in the centre of the nave, it appears [illegible] depth of about seven feet below the present pavement, there is a [illegible] bed of gravel, which, from deeper sinkings in the neighbourhood of the [illegible] is ascertained to extend to a great depth, forming what must be considered to be an unexceptionable foundation; and since the new work of Mr. Wyatt as well as the Audley chapel, remains perfectly upright, it is thus shown that the ground when properly treated admits of a solid bearing. Again as the settlements might have been supposed to have arisen from springs of water immediately under the building, search and inquiry has been directed to this point without discovering any. Immediately upon the surface of the bed of gravel, a wall *(h, k, Fig. 2)* about 5 ft. high, is placed. The stones of which it is built are rough from the quarry and are in seven courses, they are from 15 to 18 inches long at the lower part, and rather less at the upper, and the breadth of the wall is about 4 ft. greater than the bases of the piers which stand upon it; two of these walls appear to extend from one end of the Cathedral to the other—from west to east—the one receiving the northern and the other the southern range of piers as well as the piers of the central tower. The squared masonry of the bases of the piers (F, K, G, &c.) rests upon the upper surface of these walls. Of course the rough structure of the walls prevents the detection of any settlement or displacement; but I am of opinion that it is rather this basement wall, than the gravel below, which has given way, and allowed the piers to sink down and lean over as they do at present.

The walls of the Audley Chapel are, as already stated, perfectly upright, but the south wall of the Lady Chapel, against which it is erected, and into which its masonry is bonded, declines very considerably to the south; plainly, therefore, this settlement must have existed before the Audley Chapel was erected, and cannot have increased since the year 1500; on the other hand, the eastern gable of the Lady Chapel is in a state of ruinous disintegration, and requires immediate repair to save it from the fate of the west end of the Cathedral. The inclination of the walls and buttresses of the north transept, and of Booth's Porch, are original settlements, and nothing is to be apprehended from them or from that of the eastern gable *of the choir*, the entire ponderous Norman wall of which, has evidently gone to the east, and possibly its upper gable may have been reduced to such a ruinous condition as to have justified the rebuilding of it by Mr. Wyatt.

But my attention has been more particularly directed to the state of the tower, and to make the result of my observations intelligible, it will be necessary to say somewhat of the history of its erection.

It is clear that the piers and the four great arches that rest upon them are of Norman work, and that at some subsequent period, the present tower, which rises above the roofs, was added. Whether a Norman tower was ever carried above the roof, and consequently taken down to make way for the present erection, is uncertain; I am inclined to think not. The line of demarcation between the Norman wall and that of the added tower is easily traced. The upper limit of the Norman work is marked by a string course, (A, B, Figs. 2, 3, 4, 5,) ornamented with a double row of little arch-heads, and the additional work commences just above this, in a manner that will be described below. The erection of this tower is not recorded, but from the style of its ornaments, may be fixed at the beginning of the fourteenth century. The date usually assigned to it is a century earlier—it being supposed the work of Bishop de Braos; but this date, repeated by every successive historian, merely rests on a passage of Godwin, who in his biography of this Bishop,* says, "That his effigy has a model of a tower in its hand, whence he *conjectures* that he must have been the builder of the central tower." This date is thus founded upon no document, and being contradicted by the now well-understood architectural style of the tower, may be dismissed as possessing no authority. It is much to be regretted that the period of erection of no one part of this Cathedral has been recorded, with the exception of its first foundation. It is established, however, that Bishop Cantilupe died in 1282, and was buried in the Lady Chapel, that his reputed sanctity and the miracles which were said to have been wrought at his tomb, brought considerable sums to the church, and that his body was removed to the north transept in 1287; also that he was canonized in 1307.

The style of the north transept agrees with the supposition that it was erected for the reception of the shrine of Cantilupe, between his death and the translation of his body; and the superior magnificence of the design bespeaks the increase of riches and consequence which this event had brought to the Cathedral. To the same source and the same circumstances may be attributed the new tower, of which, if we place the date at about 1300, or a little later, it will appear to have been undertaken immediately after the completion of the north transept, and probably from the funds which still arose from the same profitable source. And this may account for the omission of any recorded founder or benefactor in connexion with either the work of the north transept or of this tower; for it may be generally observed, with respect to the buildings of the middle ages, that when they were carried on by their monasteries, no record is preserved of the work, but only when some considerable portion of it, as a tower, a transept, or the vaulting of an aisle, was undertaken at the expense of an individual. Thus it happens in the present instance, that the building of the Lady Chapel and its vestibule, the clerestory and vault of the choir and nave, all of them works of the twelfth and thirteenth centuries, are not recorded. To be sure Leland has recorded of Bishop de Vere, who died in 1199, that he constructed many remarkable edifices (on the authority of his epitaph), and we may assign some of these works to him if we please.

To return, however, to the tower; it is evident that at the time of the addition of the present tower, the piers and the four great Norman arches, upon which it was placed, were in a state of great dislocation and settlement.

If the *south-east* pier (H, fig. 3,) be examined in connexion with the *east Norman wall*, E, F, G, of the south transept, it will be seen that the masonry of the latter wall near this pier has been dragged downwards by the settlement of the pier. This is very visible on the inside of the building above the vault, at E K, as well as on the outside of the clerestory. It is also shown by the bending downwards of the string mouldings in the interior of this transept, at F, and also by the difference of level of the opposite impost mouldings of the small Norman arch, at G, which opens between this south transept and the south aisle of the choir; for we may assume that all these things, namely, the courses of the masonry, the string mouldings, and the two imposts of the arch, were originally respectively level. But when the respective downward dislocations of these three things are carefully measured, they are found to be exactly the same, namely, 3½ inches; and as they are situated at different altitudes, we may conclude that this pier has sunk *bodily*

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* De Præsulibus, 1616, p. 536.

downwards into the foundation through the vertical space of 3½ inches with respect to the wall of the south transept, which is of the same age as itself; but as the foundation is thus shown to be compressible, it must be supposed that the wall itself must have sunk, although in a less degree than the pier, and therefore that the actual sinking of the pier must have been greater than 3½ inches. In fact, by levelling the courses of masonry in the clerestory wall of this transept, immediately above the vault, from E to K, I find a difference of level of about 10 in. between the southern and northern extremities, which is manifestly due to sinking, and not to inaccurate workmanship, because the courses run nearly level over the piers, and sink in stages over the window heads.

A great settlement or subsidence is thus shown to have taken place between the Norman pier and the Norman wall in connexion with it, as well as a positive sinking of each into the foundation. The Norman wall of the choir has also sunk to the same extent, and as the Early English string moulding of its clerestory exhibits the same depression, we must either suppose that the depression happened after the clerestory was added, or that this string moulding was laid upon the Norman wall without levelling it, a supposition which is not inconsistent with the known roughness of the work of that age. The settlement of the south wall of the south transept cannot now be measured, because a large Perpendicular window was inserted on this side, and the wall over it entirely rebuilt during the fifteenth century; most likely because this part of the wall had been entirely shattered by the subsidence of the tower. Neither can the settlements of the tower piers, with respect to the walls of the nave, be ascertained, in consequence of the entire rebuilding of the clerestory and triforium by Mr. Wyatt.

The two southern piers of the tower being in immediate connexion with walls of their own age, their subsidence is thus as it were recorded for our information. But the two northern piers, as R, Fig. 3, are now connected with the northern or Cantilupe transept, which was built more than two centuries later, and probably replaced a Norman transept similar to the southern.

The eastern clerestory wall of this north transept, is, however, not at all disturbed by dragging downwards with the pier, and we may therefore conclude that the subsidence of the piers had ceased before the year 1300, for it will be shown, from other symptoms, that the two northern piers had in themselves suffered quite as much, if not more, from settlements than the southern ones. If then, their junction with walls two centuries later, exhibits no signs of relative motion, we may plainly infer that all the subsidence of the piers had taken place before these walls were connected to them. It is true that the western wall of the north transept exhibits a great dislocation of form; the entire mass of masonry which forms the southern side of the lofty window, forty feet high, has shrunk and slipped away from its junction with the Norman wall, and settled downwards and northwards, bulging out and bending the iron bars of the window, and rendering an immediate repair necessary. But this is a local settlement, unconnected with that of the Norman pier, and occasioned by the difficulty of establishing a firm bond between new work and old, for the clerestory and the upper part of this wall between the roofs exhibit no signs of having been dragged downwards by the tower pier.

When the great piers themselves are examined below, especially the two western, it is evident that they have suffered great disturbances. The greater part of the original Norman ashlering is now either covered by subsequent casing, or has been removed and rebuilt; nevertheless, the Norman capitals, from which the four tower arches spring, remain, and on several faces of the piers, the position of the corresponding shafts can be ascertained. This is the case with the southern face of the north-western pier, P O T, Fig. 2. The lower portion of the pair of Norman shafts, L M, remains with the bases, and one of them, M, still exists to the height of 33 feet. These shafts are still vertical, but the capitals, H K, which undoubtedly were originally placed immediately over them, are now removed by settlements, together with the entire western arch of the tower, through the enormous space of 10½ in. to the west. Also two cylindrical piers, E, F, of the nave on each side, and contiguous to the piers of the tower, are pushed bodily over so that their impost mouldings are now 4½ inches to the west of their true position; in fact every pier of the nave has gone to the west in a slight degree.

The Norman nave-arches which rest upon them have suffered a corresponding distortion of form, which is the most evident in that arch which connects the first cylindrical pier E on the north side, with the half column G that projects from the tower pier; for the half column has remained upright while the cylindrical pier has been pushed over as already described.

The Norman triforium and clerestory which once surmounted these piers, were destroyed by Mr. Wyatt, but the nature of the settlements just described—namely, that the capitals of the tower piers have gone so considerably to the west, while the lower half of the same pier remains vertical, and yet that all the piers of the nave are also driven to the west—demonstrates that the upper part P O of the pier must have separated itself from the lower, G, by a diagonal fissure extending from the upper eastern portion to the lower western, and that the western half of the mass so separated must have slipped downwards, and by pressing against the walls and columns of the nave, have produced their present change of position.

And that the upper part of this pier with the entire western tower arch, sank in this manner downwards and westwards, will also be shown from the present state of the Norman string course, A B, over the great tower arches. I should also mention that the capitals of the shafts on the western face of the north-eastern pier, Q R, have been similarly driven to the north about four inches, and that the south-western pier has undergone nearly the same settlement as the north-western. Now the upper extremities of the great piers having thus moved from their true position, the four great Norman tower arches which rest upon them, are necessarily distorted in a very great degree.

Two of these arches, the north and south, are smaller than the east and west, the respective spans being about 19 and 31 feet. Immediately above these arches, the Norman string course, A B, projects from the wall; this was of course horizontal when first executed, and its deviations from horizontality serve to mark the extent of the dislocations of the arches below it. The western arch appears to have preserved its form tolerably well, and in fact, as the two piers upon which it rests have gone together towards the west, without diverging, this arch appears to have settled bodily with them without change of form. The other three arches have suffered great disturbance; their original semicircular outline being now converted into an ellipse by the sinking of the crowns, occasioned by the divergence of the piers; for since the capitals of the north-west and south-west piers have each moved 10 in. to the west, and that of the north-east 4 in. to the north, it follows that all the four arches, except the west, have spread at the feet, and therefore must have sunk at the crown.

I have levelled and examined the present state of the Norman string course, and I find that its north-west extremity, A. Fig. 2, is 7 in. lower than its north-east, B, showing the sinking of the north-west pier, which has been already detected from other appearances. Also the north-east end, A, Fig. 3, is 2 in. higher than the south-east end, B, and on this side the string course has sagged in the middle so as to fall about 6 in. lower in the centre than at the two ends, this is produced by the sinking of the crown of the eastern arch; again, the south-east angle is 1½ in. higher than the south-west, and the string sags about 4 in. in the middle; over the western arch the string course has been removed, but the south-western angle is 3½ in. higher than the north-western. These differences are too great to be attributed to bad workmanship, and they all point to the same facts that have been attested by the other appearances described, namely, that the piers have all subsided and that the north-western has suffered the most; besides these appearances, the masonry of the spandrils—that is, of the walls included between the Norman arches below, and the string course above, is in a frightful state of dislocation; for the change of form in the arches has twisted and fractured the stones in all directions, besides drawing them asunder so as to open the joints in many places to the extent of 2 in. or more. The rubble work in the heart of the wall has lost all cohesion.

Upon these arches, however, and in this state of ruin or very nearly so, did the architect of the tower in 1300 proceed to erect his work. That this was the case is shown by the following evidence:—The masonry of the new tower begins at the level of the Norman string, A, B, or a little above it, the junction of the two works being very easily traced. About 4 feet above the Norman string, a second or Gothic string course, C, D, Figs. 2, 3, 4, 5, is placed at the same level as the passage or gallery which runs in the thickness of the wall all round the tower, and upon this string course is supported the singular row of piers, W, W, Figs. 2 and 3, or P, Q, R, Fig. 4, which constitute the interior lining of the tower.

Now the Norman string course has been shown to be completely out of level at the corners, besides sagging in the middles. But this gothic string course on the contrary, is now so nearly level with respect to the corners, that the difference may be attributed to errors of workmanship, and it has only sagged in the centre about half an inch on the east and north, and not at all on the other two sides. Also the lower bed of the first course of gothic masonry which rests upon the Norman wall, is *exactly shaped* to accomodate the sagging already described, but its upper bed is straight and level, proving decidedly that the entire present settlement of the Norman work had taken place before the tower was added, with the exception of a slight subsequent disturbance, of which I shall speak presently.

On the north and south walls, immediately above the Norman string course, may be traced a regular series of apertures, *a, b, c, d, e*, Fig. 2, in the face of the wall about 11 inches square, in which were evidently once inserted the beams of a floor or ceiling. These apertures follow the sinking line of the Norman work, and not the level line of the tower work; consequently they indicate the position of the original Norman ceiling, which is now replaced by a vault of the fifteenth century. As the lines of this vault cut through the level of the floor, this last was necessarily removed to make way for it. These holes on the north side, have been rudely stopped up with blocks of tufa—the light substance used in vaulting—from which, we may suppose that the beams were removed and the holes stopped when the vault was in progress, and consequently this material at hand.

At all events, the jointing of the masonry shows very clearly that the floor beams were not removed at the time the walls were carried up; for it is evident that the new masonry was built round and about the beams, in a way that it is not easy to describe, but which plainly shows that the beams were left undisturbed. (Vide Figs. 4 and 5, and the explanation of them at the end of the Report.)

At each angle of the tower, as at *g* and *f*, and at the same level as these beam holes, is a diagonal aperture higher than they are, and extending nearly through the wall; now the purpose of the beam holes cannot be mistaken, and we have seen that the new masonry was built round them without disturbing them, and I conclude that these diagonal holes also received some timber work, which in like manner was allowed to remain undisturbed.

The interior walls of the tower are of a very singular construction: 12 piers, W, Fig. 2, on each side, of compact masonry, beside angle piers, are carried up to the height of 26 ft., and connected half-way up by a horizontal course of stone, X, X, in long pieces, and by an iron bar, which runs all round immediately under this bonding course. Upon these gigantic *stone gratings*, if I may be allowed the expression, the interior wall of the tower rests; and they also carry the entire weight of the bell-chamber and bells. I believe this construction was entirely adopted for the sake of lightness.

It is clear that it was never intended to be seen from below, for there are no means provided to illuminate the chamber so formed, which at present derives all its light from the apertures in the floor of the bell-chamber above it. The external walls of the tower were at the time of its erection buried in the roof, of which the pitch was much higher than at present; and if windows be now inserted in these walls, I am of opinion, that besides weakening the tower in a manner, which considering its antiquity and shattered state, cannot be recommended, they will prove wholly inadequate to supply sufficient light to the chamber in question; for the piers of the grating are only 4½ in. asunder, with the exception of the middle interval, which is 18 in. Moreover the piers of the grating are of different widths, and their bases irregular, (Figs. 4 and 5,) and the whole has no decorative character; and in addition to the fact that no light was supplied to this room in its original state, which plainly shows that it was never *intended* to be seen from below, I have shown good reason for supposing that the ceiling which concealed it was only removed to make way for the vault, so that in fact it never *was* seen from below.

I have now shown, that notwithstanding the shattered state of the piers and arches, the architect of the tower imagined that they might be trusted with the support of his new work. We may at least infer from this, that the settlement had ceased to increase long before the year 1300, for it does not even appear that any attempts were made to repair or fortify the piers for the reception of the new load, with the exception of the north-western. The arch which connects this with the first pier of the nave had a new arch, Z, Fig. 2, inserted under it, and the arches which connected this pier with the north transept, both on the ground, at *q*, Fig. 1, and at the triforium, were filled up, leaving only a small doorway below. The ball-flower ornament, which is given to this new pier arch and to a string course on the west wall over this small doorway, serves to show that this work was done at the same time as the tower, which is covered with a profusion of the same ball-flowers.

However, the confidence of the architect in his old piers and arches was unhappily misplaced; the new walls which have been described as resting on the Norman string, exhibit settlements and fractures not nearly so great as those of the Norman work immediately below them, but still of a very alarming character. In the interior of the tower it is evident that the worst of them is due to the fractures of the stones over the apertures, which as already described, were occupied originally by the beams and ancient wood work. At the angles especially, the corner piers of the gratings are carried by large stones which cover the diagonal apertures, and are thus unsupported in the middle, and these stones have fractured in every instance, allowing the piers to descend more or less. Also the great eastern arch, the crown of which had sunk so considerably before the tower was added, appears to have sunk about an inch subsequently, which has allowed the stone grating on that side to descend, and has produced rents and fractures at its junction with the walls. The outer surface of the tower walls exhibits similar symptoms to those already described of the interior. At the junction of the Norman and Gothic masonry, the same sagging of the old work over the arches, and the same shaping of the new course of masonry to accommodate this sagging, may be observed, and it will also be seen, that the worst and most alarming settlements are in the old work.

Nevertheless it is evident that the dislocations of this old work had proceeded so far as to destroy the cohesion of the walls, and allow crushing of the stone work to begin, which has proceeded, and probably continued from time to time up to the present, and has now reached to such an extent as to make a thorough repair and renewal of the ashlering of this portion of the walls necessary to prevent the entire ruin of the tower. The upper part of the tower was originally so substantially built, that when the older portion has been reinstated, this will need comparatively little repair to make it perfectly sound.

Having now disposed of the tower, I will return to its piers in the church below. These piers have evidently been subjected from time to time to a series of repairs and casings which it is not very easy to understand.

I may here refer to a curious document preserved in the archives of the Cathedral which will throw some light upon their history. In this is a bull of Pope John XXII., dated 1319, by which the churches of Shenyngfeld and Swalefeld are assigned to the uses of the fabric of the church of Hereford in the usual form. But the preamble recites that whereas sometime since the dean and chapter of Hereford did, upon an ancient foundation which in the opinion of skilful masons was held to be firm and solid, erect a sumptuous building upon which more than 20,000 marks were expended; that now from the weakness of the foundation, this building so threatens ruin, that the entire fabric must be completely repaired from the foundations upwards; which they are unable to undertake, being also burthened with debts incurred in the procuring of the canonization of Thomas of Cantilupe, &c.

This document must allude to the tower and north transept, which were both of them built upon or in connexion with Norman work, the "fundamentum antiquum" here mentioned. It is important, as showing that the settlements in the new work, consequent upon its erection on so shattered a substructure, must have begun to show themselves immediately after its completion. But as the repairs which were intended to avert this threatened ruin, appear to have been confined to the piers below, and not to have been extended to the great arches and their ruined spandrils, we may conclude that the settlements were imputed to the failure of the piers alone; and it may be presumed that the movement was arrested, since we find that the present vault was substituted for the wooden ceiling sometime in the fifteenth century, to judge by its mouldings and fashion, and probably at the same time that the similar vault of the south transept was erected; for if the tower were then in a threatening state, it would hardly have been tampered with by such an alteration. It must be confessed, however, that the ribs of this vault are remarkably thin and light, and that it stands completely free of the walls on all sides, resting merely upon the four corbels. This vault must be taken down to obtain proper access to the spandrel walls in the course of the proposed repairs, but it may be replaced.

I will now describe the present state of the four piers in order:—

I have already shown that the south face of the *north-west pier* was originally traversed by a fissure, which allowed the upper western portion to descend; and it is easy to see that the whole of the Norman ashlering to the west of the fissure has been removed and entirely rebuilt. At the upper part, where the shattering and dislocation was the greatest, the face of this new work is brought forwards a few inches; but the remaining portion has the same face as the Norman work, which shows that this repair was not a mere casing like some of the others, but an actual renewal of the original ashlar. This repair is crowned by a Gothic string moulding which lies immediately under the Norman capitals; one of these capitals, K, Fig. 2, having been, as I suppose, crushed, has been replaced by a plain block of stone, and the whole of the capitals on the eastern face of this pier have been also removed and the new masonry carried much higher than on the southern face. This work, or at least the southern face of it, is probably an ancient repair consequent on the threatened ruin mentioned in the bull of 1319; but the remaining Norman face of this pier seems in course of time to have again exhibited threatening symptoms; for it has been fortified in a very singular and unsightly fashion by cramping against its face a shell of masonry, T, 9 in. thick. This masonry is composed of very long and narrow stones set endlong, but is traversed in the middle and terminated at the height of 33 ft. by horizontal courses which serve to bind the work, and probably contain iron bands for the purpose of assisting in keeping the pier together. This casing extends round three sides of the pier, occupying portions of the north and south faces, *n*, *p*, Fig. 1, and the whole of the east face, *o*, *o*; but the original Norman shafts still remain upon this latter face to the height of 23 ft., and the surface of the Norman wall, beneath the casing, does not appear to have been broken into. The whole work is apparently the contrivance of a country mason, and as such, its efficacy is not much to be depended upon. The object of the vertical beds may have been to reduce the number of horizontal joints, and thus to avoid or diminish the shrinking of the work, which is always a source of difficulty when new work is united with old. But more probably the evil to be remedied, was a bulging out of the Norman ashlering, like that which now appears on the north face of the south-western pier, and on the spandrils of the great arches, and these long stones were intended to act like the splinters applied to a broken leg.

The *north-east pier*, A, Fig. 1, is repaired in a totally different manner, being completely cased or enveloped in a coating of solid masonry, Q, R, Fig. 2 laid in the usual manner in horizontal courses, which have thickened out the pier upon the plan 9 in. in every direction, as shown at *a*, *b*, *z*, *z*, *d*, *e*, Fig. 1. Whether this masonry is also a mere shell cramped against the undisturbed Norman face of the pier, or whether the Norman ashlering has been removed and the additional work properly bonded into this pier, I cannot tell, but it is very desirable that this fact should be ascertained, as its present efficiency depends very much upon that circumstance. However this may be, it is the work of two different periods. The southern face of the pier shows a nearly vertical fissure or separation of the masonry, and the lines of the beds will be found on examination to be at different levels on the two sides of the fissure which at the bottom and near the top is a mere vertical straight joint. The western half, Q, Fig. 2, of this casing is the more recent of the two, and their line of juncture at present exhibits the appearance of a dangerous crack. This is occasioned by the inevitable shrinking of the late work from the earlier; and as the pier shows no symptoms of giving way in other respects, it does not appear to impair its stability.

The *south-eastern pier*, B, Fig. 1, retains its Norman face, on a portion of the southern side, *h*, *g*, but the western and northern faces, as well as the rest of the southern face, have been entirely and substantially rebuilt; for although the present face advances a few inches beyond that of the original Norman pier, it is evident that the Norman ashlering was in this case removed. This pier is in excellent condition, and appears to need no repair or alteration whatever. This work may be attributed to the period immediately succeeding the bull of 1319. The corbel which sustains the tower vault, and which rests upon the string moulding which caps this new ashlering, is formed in such a manner as to show that it was intended to rest upon this string course, and consequently must have been inserted after the string course was completed; the repair therefore in question, must have taken place before the tower vault was inserted in the fifteenth century; but the western face of this pier seems to have been subsequently under-pinned.

The *south-western pier*, D, Fig. 1, retains on its northern face, *r*, *s*, a portion of the Norman ashlering, with about 11 ft. of the shafts; above, and to the east of these, from *s* to *t*, the Norman ashlering has been removed and rebuilt, probably in the 14th century, when the other piers were repaired. A long corbel is advanced near the upper part, which carries a projecting pier of masonry, for the purpose of supporting the original Norman capitals, which have been respected and preserved as much as possible throughout all these repairs and alterations. This pier, has at some subsequent period undergone a second repair upon its eastern face, which has been underpinned and brought forward about 10 in. to the east. This work, *t*, *v*, which is also carried round the southern part of the pier, only extends to 20 ft. in height, and then falls back with a chamfer to the original face. It exhibits no signs of settlement, and appears to have been firmly and substantially executed; but the junction of these three different works upon the plain northern face of this pier, greatly increases the shattered appearance of its masonry, for each boundary line, at first sight, looks like a fissure. Also the half round pier, *r*, *w*, which received the first arch of the nave, has been rudely cut into for the insertion of the pier of a pointed arch, which has been substituted for the Norman arch on this side of the nave; for as the tower pier in question had declined to the west, as already explained, exactly as the opposite pier had done, the Norman arch, on this side, must have been distorted and shattered in the same manner as the opposite one, Z, Fig. 2, and probably in so great a degree as to render it necessary to replace it entirely.

In addition to the various repairs of the piers thus detailed, most of the Norman arches in connexion with these piers have been filled up with solid masonry, leaving only doorways. The only one in fact which remains untouched, is the arch which opens between the south transept and the side aisle of the choir. At what period these and the other repairs were executed, it is not easy to determine. However, these fillings up, as well as the piers of the ox-eye masonry, are shown in the plan of Hereford Cathedral given by Browne Willis, in 1727. This is, I believe, the oldest plan extant, for the Monasticon contains no plan of this Cathedral. Perhaps some of these works are due to Bishop Bisse, who is recorded in the former work as having caused the whole fabric to be repaired, and the choir new beautified throughout. He occupied the see from 1712 to 1721. The *ox-eye masonry* is so termed, because the centre of it is pierced by an opening in the form of the ancient *vesica piscis*, called by workmen, an ox-eye.

This masonry, W, Fig. 2, completely fills up the two smaller arches of the tower, namely, the north and south, and is itself supported by two segmental arches branching from an octangular central column. It was, of course, intended to support the arches and tower in their evident state of dilapidation, but it is impossible to conceive a more injudicious or useless work than it presents; in fact, the masonry is so absurdly arranged, that it is unable even to support itself. Its mass has settled in two parts upon its two segmental arches, straightening them and descending and abandoning the arch it was intended to support. The settlements and fissures which now appear in this masonry, are merely the effects of this change of form, and as I do not believe it has had the slightest influence, either for good or evil, upon the building—it may be with safety entirely removed.

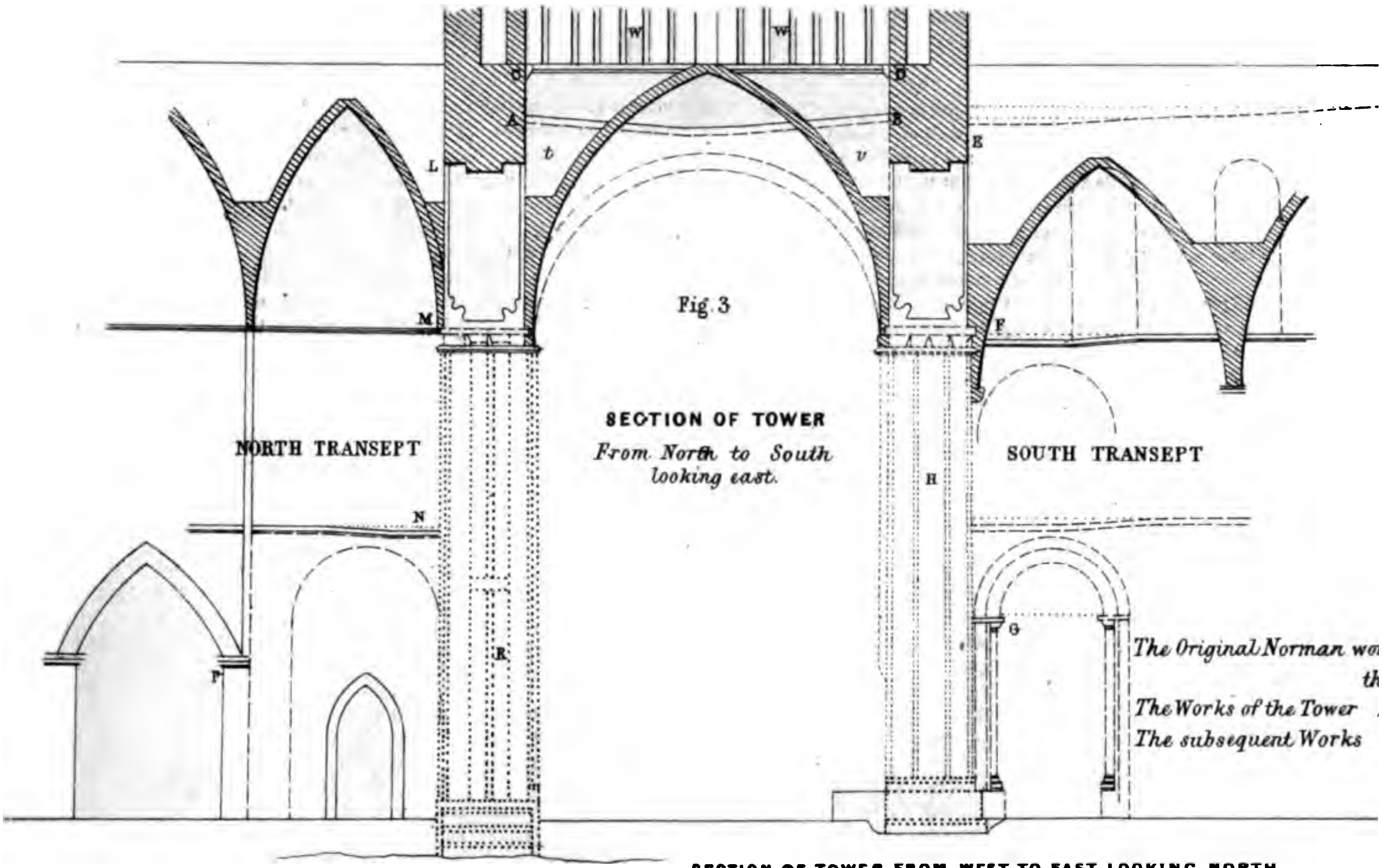
I have thus attempted to develop the causes which have brought the building to its present state; and have endeavoured to show that the settlements are of great antiquity, and that many of them are of such a nature, that no apprehensions need be entertained from them, they having taken place immediately after the completion of the work, and not having yielded since; also that many of them have arisen from the injudicious junction of the new work with old. But when the facts of the fall of the west end in 1786, and the evidently impending ruin of the eastern gable of the Lady Chapel are considered, there is too much reason to fear that some of these early settlements may have extended so far, in the first instance, as to weaken and destroy the integrity of the walls, so as to allow them to sink and be crushed under the weight of the subsequent additions. This is evidently the case with the four great Norman arches, the masonry of which and of the spandrel walls above, is in such a state of ruin as to make an immediate repair absolutely necessary for the preservation of the tower. The piers upon which these arches rest, have been, as we have seen, subjected to a series of repairs, many of which have been so substantially executed as to make them perfectly safe. This is especially the case with the south-eastern pier, which is in excellent order, and with the north-eastern, which exhibits only an original vertical fissure, from which nothing need now be apprehended. The two westerly piers are not in such good condition, and these, as we have seen, did, in the first instance, suffer much more from settlement than the others. The mode in which the north-western pier has been repaired or bolstered is unsightly, and may conceal a state of ruin which it is inadequate to prevent. Also the north-western portion of this pier exhibits some fractures, from which there is too much reason to suppose that the heart of the work is in a very unsound condition. For which reasons it would be desirable to remove this casing, and subject this pier to a thorough repair, in the course of which the real state of the internal parts will become evident, and an opinion may be formed of the necessity for a similar operation upon the south-western pier, of which the northern face exhibits in some parts signs of weakness, which may be merely superficial, but which at all events call for examination and repair.

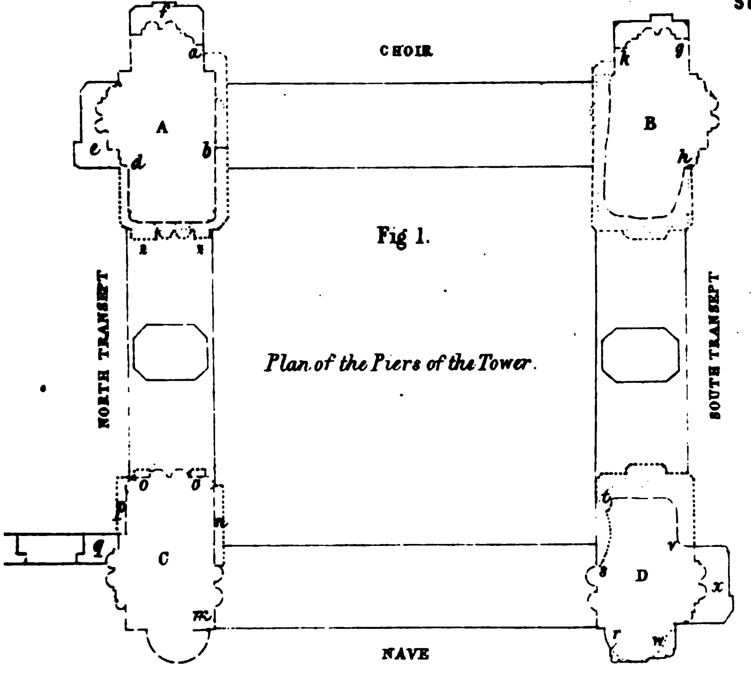
I do not think it necessary or expedient to restore the original form of the Norman piers. The repairs, which are, as I have shown, themselves of a sufficient antiquity to claim respect, have so far advanced the faces of these piers in many places, and removed the Norman shafts in others, and the settlements have so disturbed the capitals from their true positions, that any attempt to restore the original form and to replace the shafts must be attended with very great expense. The existing mode of capping the restored ashlering with a Gothic string, immediately under the Norman capitals, answers every purpose of uniting the two works, with a due regard to appearance.

To the very Rev.
The Dean and Chapter of Hereford,

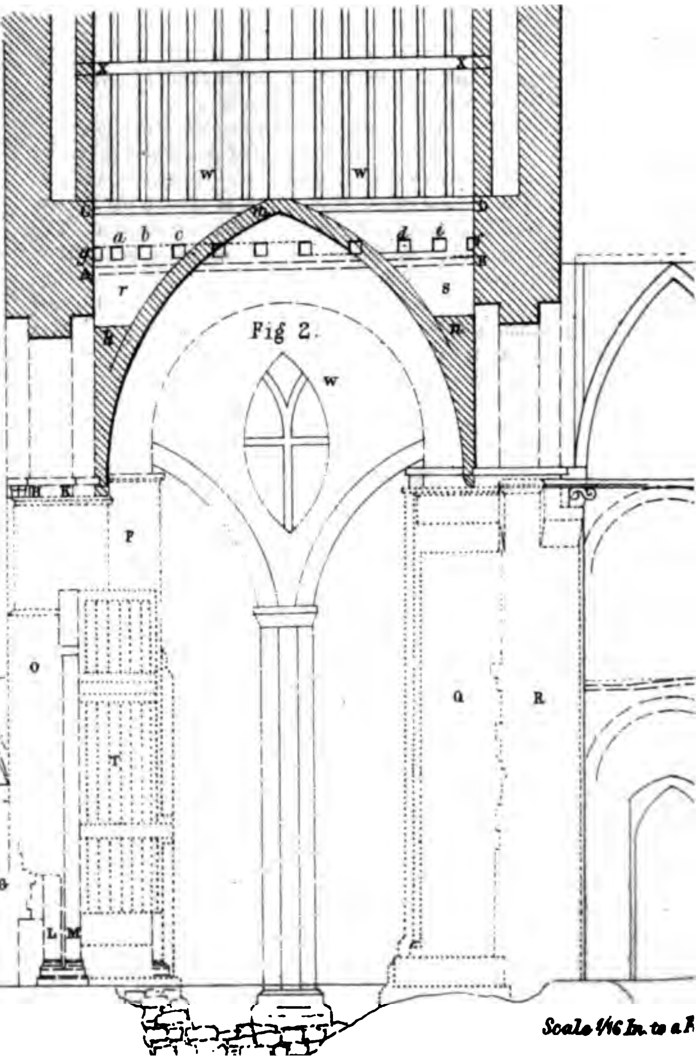
Robert Willis.
Cambridge, Oct. 12, 1841.

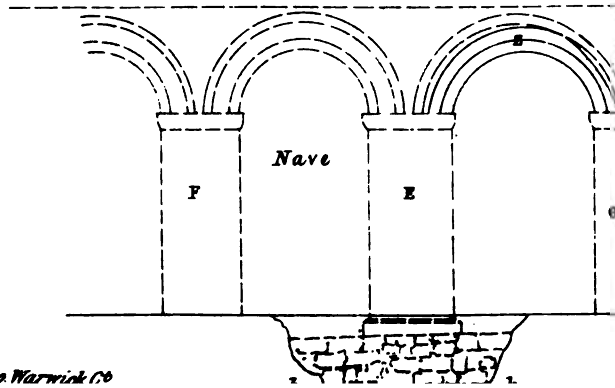
HEREFORD CATHEDRAL.





SECTION OF TOWER FROM WEST TO EAST LOOKING NORTH.





T.R. Jobbins litho Warwick C°

Scale 1/16 In. to a F

PART OF NORTH WALL OF TOWER.

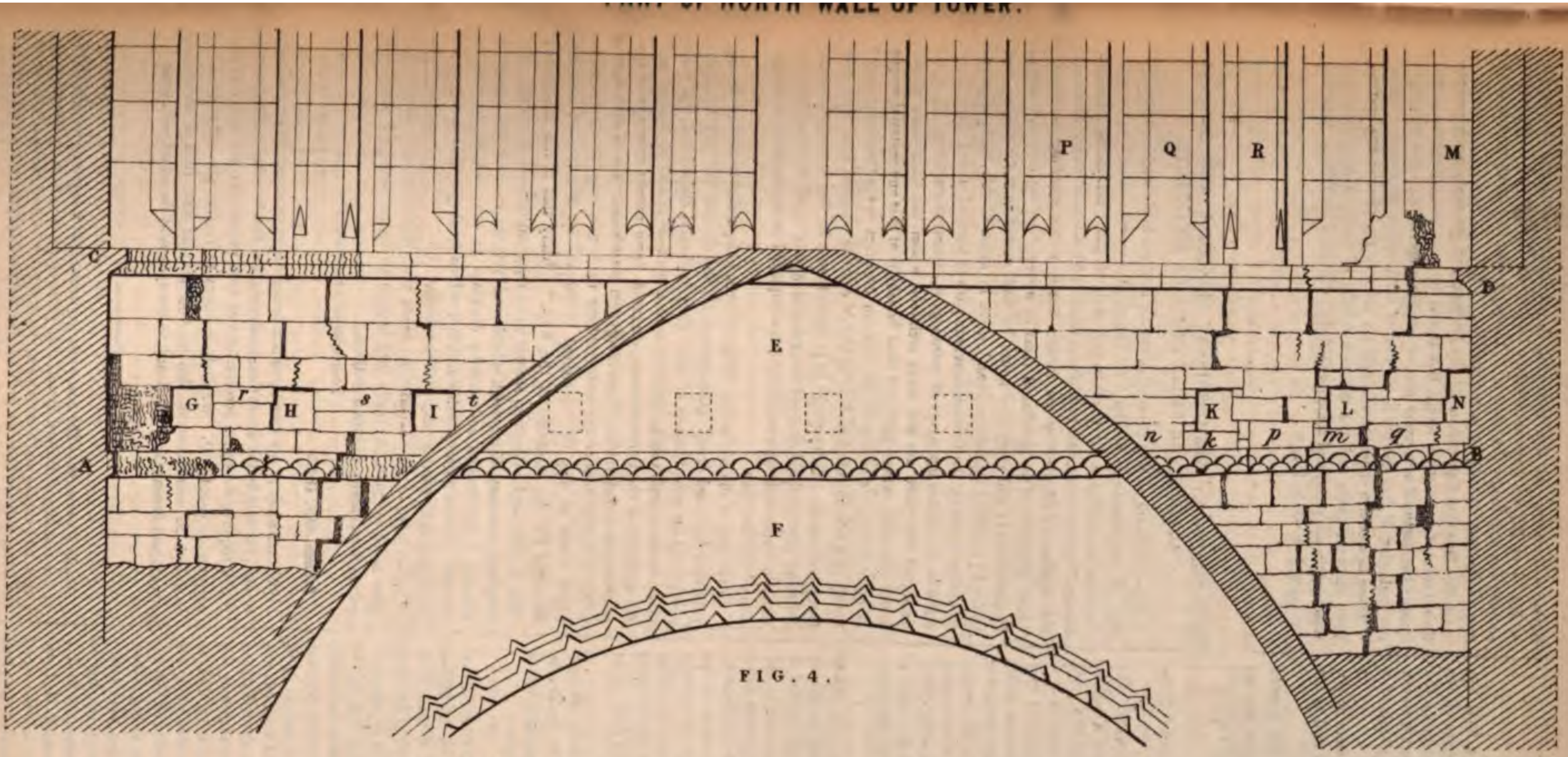


FIG. 4.

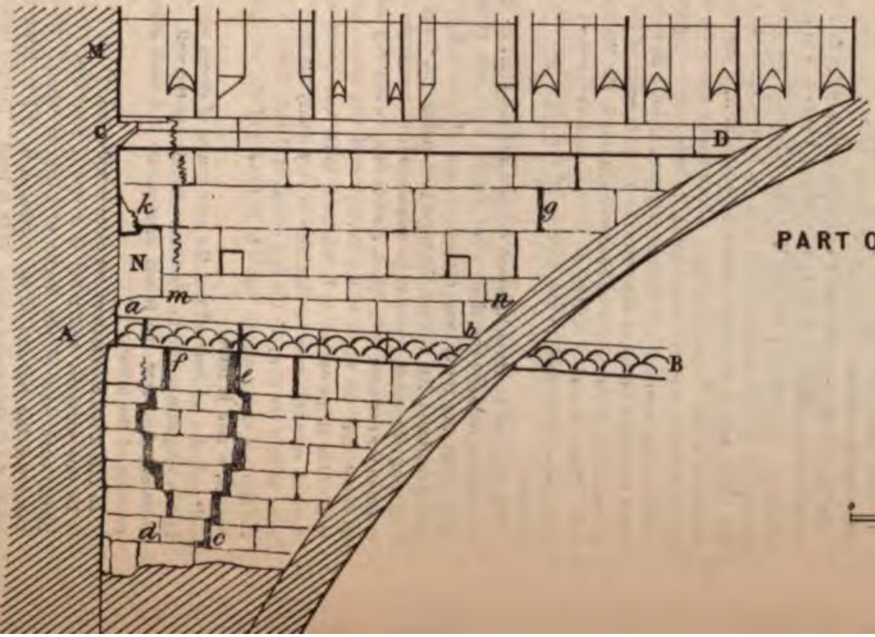
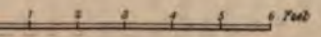


FIG. 5.

PART OF EAST WALL OF TOWER.



R. Willis, Del.

N.B. Fractures are indicated thus ⁞

Additional Remarks.

Figs. 4 and 5 (Plate XIV) represent on a scale of ¼ inch to a foot, the portions of masonry above the vaults of the tower, for the purpose of exhibiting more clearly the nature of the dislocations and the union of the Gothic masonry with the Norman. In these drawings the separate stones are laid down with great precision from actual measurement to a scale of a ¼ of an inch to a foot.

Fig. 4 corresponds to the upper part of Fig. 2, and shows the state of the masonry of the portions of walls marked *r* and *s*, in Fig. 2, as well as the bases of the tower grating.

The surface of the wall below the vault at E and F, (Fig. 4), was covered with paint so that the joints of the masonry could not be seen, but the surface above was easily accessible, and had never been painted or stopped with cement.

Fig. 5 represents the portion of east wall marked *t* in Fig. 3.

In both these drawings A B is the Norman string course, and C D the Gothic string course.

As Fig. 5 is the simplest case I will explain that in the first instance. The Norman string course A B is 3½ in. lower at *b* than it is at *a*, and is besides dislocated; the masonry beneath it is also dislocated and exhibits two great fissures, *c e*, *d f*, of which the first is 2½ in. wide at *e*, and the second 1½ at *f*. The north wall of the tower, shown in section at A, is also thrust back very considerably from its proper place. The masonry above the Norman string course is on the contrary close jointed, its beds remain very nearly level, the Gothic string course C, D having only sunk about ½ an inch in the centre. There is a slight fissure or dislocation at *g*, and in some of the other joints, but not at all of the dangerous character of those in the Norman work below A B. There is also a settlement accompanied by fractures at the angle *k*, but this is occasioned by the sinking of the angle pier M, of the superstructure.

The diagonal aperture N, which extends into the heart of the wall, and in my opinion formerly contained some timber work, was allowed to remain open when the tower was carried up, and the stone *k*, which covered it having fractured, has allowed the angle pier to descend, dragging with it and fracturing the other stones in its neighbourhood, but producing more dislocation in the northern wall, Fig. 4, than in this. In this east wall there can be no doubt that the whole of the Norman work was taken down as far as the level of the string course, A, B, when the tower was carried up, and that the Norman spandrils were at that time in very nearly the same state of settlement as they are now, for the first course of Gothic stones, *a*, *b*, that lie upon the Norman string are cut below to fit the sag of the latter, and their upper bed, *m*, *n*, now is level.

It wtll also be observed that the next course of stones upon *m*, *n*, has been laid in long thin pieces to give more cohesion to the wall. The smaller fissures at *g* shew that the rotten substructure had sunk subsequently to the erection of the tower.

In Fig. 4 the appearances are more complicated.

In this northern wall there is a row of apertures, G, H, I, K, L. that plainly once received the beams of a floor or ceiling. Now on this side of the tower the Norman string course, A B, is 7 in. lower at A than at B, while the Gothic string course, C D, is level. But the beam holes are equidistant from the Norman string course, and are raised about 5½ in. above it. Plainly, therefore, they belong to the Norman structure and not to the Gothic, for they have sunk together with the Norman work, while the Gothic remains level. When the Gothic work was raised the Norman masonry could not have been taken down on this side completely to the string course, A, B, but the Norman stones beneath the beams must have been at least left undisturbed. That this was the case is clearly seen at K and L, for the stones *k*, *m*, that laid under these beams, are 5½ in. thick, but the stones of the same course *n*, *p*, *q*, are of different thicknesses, *n* being 7 in. and *q* 6 in. so as to restore the level for the upper beds. The little square stones which are packed in at the corners of these holes, and the correspondence of the general level of the intermediate masonry with that of the Gothic string course, all show plainly that although at this end of the wall the beams were undisturbed, yet that the whole of the masonry was removed above them, and on their sides with the exception of the stones, *k* and *m*, that supported them.

At the other end the Norman masonry between the beams, G, H, I, appears to have been quite undisturbed; *r*, *s*, and *t*, are in this case the upper remaining Norman stones, and this is also shown by the fact that the plane of the whole Norman wall, *including these stones*, is 4 in. in advance of the Gothic wall above. At the other end, B, (as already mentioned and shown in Fig. 5 at E,) the Norman is driven behind the Gothic wall. Upon examining the wall below the vault at E, the projection just mentioned may be seen to die away to nothing in the middle.

On this face the dislocations of the Norman wall are again much greater than those of the Gothic wall. But it will be seen that the stones of the latter have fractured over every one of the beam apertures. The sinking of the angle pier, M, has also produced a set of crushings in the masonry below.

These figures also show the dissimilarity between the piers of the grating, their different bases and the different widths of their chamfers, some of which again are plain, and some swelled with the usual moulding. Compare for example P, Q. R, Fig. 4.

ECCLESIASTICAL COMMISSIONERS' MONOPOLY AND CRUSADE AGAINST THE EMPLOYMENT OF ARCHITECTS.

Sir—There are no very cheering prospects held out to the architects of this day, if the intentions of the "Ecclesiastical Commissioners" as regards "houses of residence for the Clergy," and of the "Education Commissioners" as regards schools and houses be carried out to the letter. Amongst the regulations adopted by the former Board is the following:—"Every house proposed to be purchased must be surveyed by the architect of the Commissioners; and every new house be built *according to his designs, and under his exclusive superintendence*." Now in cases of this kind, wherein an outlay of £900, the Commissioners require to have advanced *them* from £450 to £540, this monopoly of patronage is somewhat startling. Is it to be argued that there are not many architects whom the Clergymen would prefer to employ, whose taste and *local knowledge* of cost and material would be quite as valuable as that of the London architect to the Commissioners? Surely it would be sufficient that he should exercise controul as to their cost and construction. There would be as much reason in the metropolitan and Diocesan Church Building Societies refusing grants to all applications, but those in which their own architects were employed in the erection or alteration of the churches.

In the case of the Education Commissioners, independently of their having published "cut and dried" plans, elevations, and sections (of very questionable merit) for school houses of every size; applicants are advised, "If their plans do not exactly suit to point out such alterations as may be desired, and the architect of the Commissioners will send down careful drawings of the ground plan and elevation;" and clergymen are advised "not to avail themselves of the services of the local architect until this stage of the proceedings," when he may be "requested to prepare specification and working drawings for the execution of the work." Really this is too impudent! Men of taste and education are not to be supposed capable of *properly* arranging a trumpery little parish school, and yet are to be called upon to prepare a specification and working drawings to carry out another man's design! I trust no respectable architect will so far forget what *is due* to his profession as to comply with such proposals.

I must leave to more experienced heads the suggestion of a remedy for these barefaced jobs, (for really they deserve no milder term); I could not refrain from calling attention to them.

Your obedient servant,

London, Oct. 1842. T. H. W.

[We are sorry to say that there is a strong desire to adopt this centralizing system, not only by the above Commissioners, but also by other public boards, which requires the active perseverance of both professions, the architect and engineer, to counteract. We shall be happy to receive any information on so unjust an encroachment, that we may grapple with such a formidable enemy, and endeavour to put a stop to the system at the onset.—Editor.]

Wood Pavement.—The first wood pavement that was put down in London, at the east end of Oxford Street, four years since, is now being reversed and relaid, and causes much surprise by its great durability, many of the blocks not being reduced half an inch of their original length, which was one foot, though exposed to all the traffic of Oxford Street.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.

SECOND COURSE—LECTURE XIV.—WORKING EXPENSES OF RAILWAYS.

Mr. Vignoles commenced by reminding the class, what he hoped they duly felt, that the great object he had had in view during the present course was to consider, in every bearing, the proportion between the cost and expenditure upon any work, as compared with the probable profitable returns. Although this consideration, and that of the good result of any such speculations, might be thought not to come strictly within the duties of an engineer, and until of very late years had been neglected, and, in some striking cases, absolutely repudiated, by eminent men, yet Mr. Vignoles was of opinion that it must ever be kept in view, and should absolutely form a branch of the engineer's study, for he ought to feel that any works he may be called on to construct should not only be such as will reflect credit on him, as a professional man, for design, arrangement, and execution, but, as the Professor had often urged, such as, in this commercial country, where private enterprise and speculation attempts and effects so much, will, by their success, prove the accuracy of his judgment, and his capacity, as an adviser, to lead spirited undertakers into future operations of the same kind. In short, that the success of an engineer depends, perhaps, more on the beneficial results of his works to the proprietors, as commercial speculations, than on his own masterly conquest by art over natural difficulties. But the engineer should further look at this subject in a higher point of view, and consider that all unprofitable expenditure is so much waste of the resources of a country, and that, of all professions in society, his is the one most called upon to direct the laying out of large sums on what may truly be considered national objects, for the judicious and beneficial results whereof he is responsible, and, consequently, whereon his reputation must ultimately depend. Referring to an expression in a late lecture, the Professor observed, that he by no means intended to represent that it was not necessary, in the construction of railways, to reduce the natural undulations of a country to uniform inclinations, but that it was to be maturely considered at what cost such advantage is to be acquired, keeping constantly in view a comparison of this cost with the working expenses of a line more or less perfect. It was the investigation of these *working expenses* that was now to be entered on. In proceeding to do this, Mr. Vignoles observed that he considered it by far the best way to reduce to a mileage not only their gross sum, but also each of the items, these being again subdivided as far as possible. By a "mileage" he understood the result arising from dividing the periodical amount of the expenses by the total number of miles run by locomotive engines *with trains after them.* The Professor insisted that this was the proper way, and gave a number of reasons for his opinion, and for not at all considering the expenses with reference to any proportion they might form of the gross receipts—the two sources of income and expenditure being perfectly independent of each other; and Mr. Vignoles further thought this mileage comparison was the only one from which correct results could be drawn, and whereby materials and experience might be collected, so as to result in the practical benefit of companies being able, before long, to enter into contracts for most of the items of expenditure at given rates. Some companies had already contracted with each other for the supply of locomotive power, carriages, &c. at a mileage; the maintenance of the way was now almost universally paid for by the lineal mile of rail, and he had no doubt but that, after a little more experience, other of the working expenses of railways would form subjects of such a kind of contract.

Mr. Vignoles then proceeded to enumerate the general heads of these expenses, viz. 1, *locomotive power*, subdivided into drivers' wages, fuel, oil, hemp, &c. ordinary repairs, water and fuel stations, reserve fund; 2, *carriages*; 3, *maintenance of line*; 4, *police*; 5, *conducting traffic and stations*; 6, *rates and taxes*; 7. *Government duty*; 8, *miscellaneous charges*; 9, *management*. These were the proper items, exclusive of interest on loans, which, although to be deducted before a dividend could be made, of course formed no part of the positive working expenses of a railway. The Professor then went into a minute analysis of these several items, as actually disbursed on certain railways of various lengths, and particularly of various gradients, explaining the reasons of excess or of diminution in one or other item on the respective lines, exhibiting also comparative tables, and making many valuable observations upon obtaining the best attention and greatest economy from the servants of a public company, by instituting premiums graduated in proportion to the diminution of annual working expenses.

Locomotive power.—In considering this item, Mr. Vignoles showed, from an average of a number of lines, where the arrangements were properly established, and the railway had been long enough at work to have got all matters systematically arranged, the subdivision per mile per train might be taken as follows—viz. wages, 2*d.*; fuel, 4*d.*; oil, hemp, &c., 1*d.*; making 7*d.* per mile as the mere cost of motion, exclusive of repairs of any kind. This might be considered as applicable to an average of six or eight carriages per train. Heavier trains only came occasionally in the course of the 24 hours, and unless upon lines having exceedingly favourable gradients, auxiliary engines were then applied, the cost and mileage of which being included in the annual accounts, the above rate of calculation would still apply. On railways not having a very considerable traffic, the number of carriages, on the average, were fewer than above stated, and the engine and tender might be fairly taken as constituting half the gross load of each train. The items of wages and oil, hemp, &c. would not materially vary on different lines, except, perhaps, the first, or on short lines with very great traffic, with quarter or half-hour trains, such as the London and Greenwich Railway, the Dublin and Kingstown, &c. The fuel would be a variable quantity, but it would rarely exceed 6*d.* Next must be taken the ordinary repairs, and the Professor stated that in no case was the old adage of "a stitch in time" so applicable as in a constant vigilance and daily inspection and remedy of the smallest defect in locomotive engines. A plentiful stock of engines of the very best materials and workmanship, and an efficient and roomy repairing establishment, though somewhat costly at first, would be found to be the means of keeping down the expense of repairs to a low figure. The amount of this item spread over a year's working appeared to average, on well-regulated lines, about 7*d.* to 8*d.* per mile; some instances had been as low as 6*d.* The expense of water and fuel stations varied from ¼*d.* to ½*d.* per mile. The reserve fund was an arbitrary charge; Mr. Vignoles assumed that about 10 to 15 per cent. on the ordinary repairs would be sufficient—say 1½*d.* Thus it would seem that the total cost of locomotive power ought to be about 15*d.* or 16*d.* per mile per train. In some instances it had been reduced so low as 1*s.*; in others this amount had swelled to 18*d.* and even up to 2*s.*

Mr. Vignoles then analysed the other heads of the working expenses—viz. carriages, which he seemed to consider an expensive item, varying from 4*d.* to 6*d.* per mile per train—say from ½*d.* to 1*d.* per carriage per mile, including the various descriptions of vehicles for passenger traffic. The maintenance of the railway varied most remarkably, from 2*d.* per mile per train (which had been the cost on the Dublin and Kingstown Railway, and was now even lower, and Mr. Vignoles believed that on the Greenwich Railway this was also a small item, since they had replaced their stone blocks by timber supports), up to 1*s.* per mile per train, which was the cost on several lines; but, on a railway with the upper works properly constructed, he thought that 6*d.* to 8*d.* per mile per train ought to keep a double road in good order, including a reserve or depreciation fund for renewing the iron rails—a contingency that should by no means be lost sight of. The Professor here made a long digression on this item, as to how much of the cost should be assigned to atmospheric causes, and all collateral and contingent circumstances; how much to the mere dislocation of the upper works; and how much to the positive wear and tear of the iron: and pointed out some remarkable instances of saving in maintenance, where the longitudinal timber bearings had been adopted. The charge of police varied from 1*d.* to 6*d.* per mile per train, according to the vigilance exercised; in placing 2*d.* per mile as an average it was to be considered only as an approximation. Conducting the traffic and stations was an item that did not seem to differ much on the various lines; for the passenger department it appeared to be about 5*d.* Local rates and taxes would, of course, vary materially; the poor rate formed a serious charge on all railways; this item was indirectly contingent on the actual profits of the company; it appeared, however, to be seldom less than 3*d.* per mile per train. Government duty had heretofore been computed at ⅛*d.* per passenger per mile—henceforth it was to be calculated at 5 per cent. on the gross receipts for passengers only. This would, of course, make greater discrepancies; still, as the new duty on the gross was estimated to be equivalent to the old duty, an account might be obtained if the number of passengers per train were known. Assuming this number to average forty, taking all the railways of the United Kingdom, the Government duty might be estimated at 5*d.* per mile per train. Taking a mean of four or five railways, the miscellaneous expenses were found to be about 2*d.* and the management about 3*d.* per mile per train. Now, to make a summary of all these, which was, however, to be taken generally, and, of course, liable to be affected in the details, but was still interesting to be submitted in a popular form, and might be useful as giving a comprehensive view of the system:

Abstract of the average working expenses of a railway per mile per train.

	s.	*d.*
Locomotive power—viz. wages, 2*d.*; fuel, 4*d.*; oil, hemp. &c. 1*d.*; ordinary repairs, 7*d.*; water and fuel stations, ½*d.*; reserve fund, 1½*d.*	1	4
Carriages	0	4
Maintenance of line	0	8
Police	0	2
Conducting traffic and stations	0	5
Local rates and taxes	0	3
Government duty on passengers	0	5
Miscellaneous expenses	0	2
Management	0	3
Total	4	0

Mr. Vignoles did not, by any means, pretend that this was other than a probable approximation. Some lines had been worked at a lower rate per mile per train. including all the above expenses; for example, the latest accounts of the North Union Railway show the cost to have been only 3*s*. 4*d*., not including any funds for reserve. The Professor himself thought that 3*s*. was a fair sum, exclusive of taxes and duty, which, however, together form a large proportion of the expense. On the other hand, there were instances in which the expenses had gone up to 5*s*. per mile per train. He considered it would be a great public benefit if all railway companies, in their reports, would give fuller details of the working expenses, and state the number of miles run *by trains*. Some few boards set a very good example in this respect. This was sometimes done for locomotive power, but the miles should only be computed as actually run with the trains, and not to include the various extra distances passed over in manœuvres, piloting, signals, &c., which, though necessary, were not part of the actual mileage of trains.

The Professor then drew the attention of the class to the fact, that the locomotive power formed about one-third of the gross expense, and of that one-half only is likely to be affected by the gradient or load, being only one-sixth of the whole of the working expenses, which was but a small item upon which a saving was to be made, to justify a railway being constructed theoretically perfect, unless the traffic was likely to be continued, regular, and very heavy. He further observed, that though he had proposed, for the sake of an easier comparison, to reduce all the items of the working expenses of a railway to a mileage per train, it was manifest that a considerable addition to the number of trains daily, and, of course, to the number of miles run, would very materially affect the locomotive power only. The taxes would be contingent on the receipts; and all the other items would be increased but in a very small degree, on the annual totals, by an increase in the number of the trains, with a carriage or two less at a time. It was important to remember this, as it affected greatly the question of laying out railways. Mr. Vignoles insisted that the extension of railways in England, especially in remote districts, would not be carried into effect until this subject had been more closely analysed, and had become better understood. Looking at the practical working of the Newcastle and Carlisle, the North Union, the Manchester and Leeds, the Sheffield and Manchester, as far as opened, and other lines, all having very heavy gradients, and contrasting their working expenses with those of lines whose inclinations were much more favourable, the average cost per train per mile did not vary greatly. Lines which had been formed at a cost of from £50,000 to £60,000 per mile, a large portion of which was to obtain perfect gradients, seemed to require little less to work them than lines costing only from one-third to one-half that sum. It is true they might be able to carry heavier trains, and did so carry them occasionally, but the average was very nearly what had been stated, and, besides, the public were best accommodated by lighter trains going more frequently. The Professor said, he could only hope that his arguments would draw attention to the subject, and that when, after the analysis of the cost of all the railways had been brought out in the way shown in his last lecture, and that of the working expenses, as in the present one, materials would be obtained for the solution of the problem, of what must be the rule for constructing lines of passenger railways hereafter.

LECTURE XV.—WORKING EXPENCES OF RAILWAYS (*continued*).

Having, in the last lecture, analysed the working expenses of railways, in reference to the train—that is, reduced to a rate per train per mile, with an average load at the usual velocity, the Professor considered it might be well to consider the same subject in another light. In the preceding mode of calculation no regard was paid to the amount of what might be called the useful weight carried. It seemed to the Professor, that the proportion between the dead weight of the engine, tender, and carriages, and the weight of the passengers and their luggage—in short, between the unprofitable and the profitable load—formed an important element for consideration, even if it did not affect the principle on which railways ought to be worked. In the common omnibus, with a full complement of passengers, the proportion was one to one—taking the average load, about five to three—or including the weight of the horses (the moving power which has also to carry itself) about three to one, or, with a full load of passengers, something less than two to one. But, on the railway, owing to the far greater weight of the carriages, and general arrangement on most lines, the proportion of dead weight is much greater. In a first class carriage, as adapted for long lines, and fully loaded with passengers and their luggage, the proportion is two and a half to one, but, taking the average load, it is about four to one, and, when but little luggage is taken, four and a half and five to one. On short lines, where the trains run often, with many carriages, the proportion is sometimes as high as eight to one, or, including engine and tender, as twelve to one. In an ordinary train of about seven carriages, their weight, and that of the engine and tender, may be taken at about fifty tons; the average number of passengers has, on a former occasion, been shown to be about sixty per train, or four tons without, and, perhaps, five tons with, their ordinary weight of luggage, and say one or two tons of packages and parcels paying freight, being a proportion of six or seven of unprofitable to one of profitable load; and if the carriages were all full, about four and a half or five to one, as above, and on the average, the proportion might very fairly be taken as at least five to one. It appeared to the Professor that there was some radical error here, and that some arrangements were wanting to reduce this proportion, as far as the carriages were concerned, for of course, as long as the locomotive engine was used, its weight would always form a large proportion of the load, particularly with light trains—though the carriages certainly required to be made strong and heavy on this system—and this seemed an inherent defect on this principle of locomotion, perhaps quite irremediable. Yet, at all events, on many lines the proportion of dead weight of carriages was much too great, and might be remedied. Of late this had been done on the Greenwich Railway, where, by combining two classes of seats in the same vehicle, much fewer carriages sufficed. There was a great contrast to this on the Blackwall Railway, where, from having a separate carriage for each station, according to the peculiar mode of working that line, the proportion of dead carriage weight was generally about three, and often four, times as much as on the Greenwich, though the carriages were of the same build. Owing to this and to other causes, extra guards, rope, &c., notwithstanding the generally admitted economy of stationary power, the expense of working the Blackwall Railway, per train per mile, was double what the Professor found was the average for the working on several locomotive lines, and quite as high, if not higher, than the present rate of working on the Brighton Railway, which was the highest of any that had yet come under his cognisance. Although, abstractedly, this over proportion of dead weight carried was not always connected with the moving power, yet an engineer ought to point out, and, when within his control, to remedy such an evil, as the loss consequent on carrying useless weight is equivalent to that arising from increased resistance of gravity in surmounting an unnecessary ascent—a case which every engineer is naturally anxious to avoid.

In the mode of reducing railway expenses to a mileage, adopted in the last lecture, the number of passengers, and their proportion to dead weight of carriages, had not been considered, for it was clear that the arrangement of carriages in any train being supposed to be duly proportioned to the average traffic, any addition to the average assumed load would be pure profit, and would not cause any sensible addition to the cost of the transit of the regular load, for which all the necessary arrangements of engines, tenders, carriages, guards, stations, and the whole working and carrying establishment of the railway was already provided and paid for. But, suppose another mode of considering the working expenses be adopted, viz. from the number of passengers in a train, deduced from an average of many lines for several years, or from any assumed number per train, let the cost per passenger per mile be worked out, and this will lead to the consideration of the true policy for attracting the greatest number of persons, and trying to fill the trains up, as they must go, at any rate.

The Professor then went through the various items of railway expenses stated in the former lecture, and brought them out in decimals of a penny per passenger per mile—the result being, that, taking account of experience gained and applied, and economical arrangements duly introduced, the expense of locomotive power might be taken at ¼*d*. per passenger per mile, which was coming back to the original estimate made for the working of the London and Birmingham Railway. Other expenses, including Government duty, would bring the total up to two-thirds of a penny, and, under favourable circumstances, of well filled carriages, this might sometimes be brought down to ½*d*., but taking the average of lines as now worked, the cost was about 1*d*. per passenger per mile. On many of the American railways the cost was as low as ¼*d*., and for long lines on the continent, in India, &c. where wages were low, and coal or wood might be got very cheap for locomotive fuel, and no rates or taxes on profits and passengers were laid, the charge of carrying passengers per mile might be fairly taken at ½*d*. only. Now, if the proportion between the unprofitable and the profitable parts of the load were reduced to three to one, as regarded carriages only, and six to one as regards the whole weight of the train, the expense of carrying passengers, taken by weight, will be still at least three times as expensive as carrying goods only at the same velocity, the proportion being of wagons to goods as two to three, and of the whole train, including engine and tender, at less than two to one, and with heavy trains, of goods only, about one to one, and for coal and mineral traffic, at diminished rates of travelling, still less. The Professor observed, that the cost of conveying merchandise might be taken at about 1*d*. per ton per mile for railway expenses only, exclusive of collection and distribution at the termini of lines, and that of coal and minerals at about ½*d*. per ton per mile. With these elements, therefore, of the expense of working railways either per train, or per passenger, or per ton, it is for the politic manager of a public concern to consider what should be the rate of charges above these cost prices to make to the public, so as to induce the greatest amount of traffic. Mr. Vignoles then observed, that there was a third way of considering the subject of the working expenses of railways, in reference to the number of engines employed, which was the mode adopted by the Irish Railway Commissioners, and which was, perhaps, the proper way of calculating the annual cost on lines of little intercourse, on which, however small the traffic might turn out to be, yet a certain number of engines must be kept to do any work at all. The commissioners, in following out this inquiry, endeavoured to determine the proportion the cost of locomotive power bore to the total working cost of a railway. For the Liverpool and Manchester line it was found that this proportion was only one-fourth the gross annual charges on that line, including much town carriage of goods collected and delivered; but on the Dublin and Kingstown Railway the proportion was, at that time, nearly one-half. It was observed by the Professor, in a digression, that for the average of railways it was now determined to be about one-third. The commissioners finally assumed the cost of locomotive power to be one-third of the total expense of working a line of mixed traffic, and that to run a given number of trains per day, a certain number of engines must be provided; it was then calculated that £1750 a year would be the cost of each engine to work about from 25,000 to 30,000 miles annually, and then they computed the amount of gross receipts necessary to cover those expenses and interest of capital. This was working backwards, to ascertain whether it is justifiable to make a railway at all in certain districts. The result of the commissioners' calculations were, that, supposing there went only two trains daily throughout a given line, the average load of each train ought to consist of either fifty tons of goods or eighty passengers, or a mixed load of twenty-five tons of goods and forty passengers, or in that proportion, in order to justify a line being made—the average charge for passengers being assumed each 1¼*d.* or for goods 2*d.* per ton per mile, which, it may be observed, is scarcely the half of the average rates of charge on the principal English railways. Mr. Vignoles observed, in conclusion, that having shown that the cost of conveyance of passengers, merchandise, minerals, &c., could be nicely calculated from the experience gained, and could be brought to the definite mileage rates before mentioned, *he thought the proper railway charge should be, double the cost for working;* which, when the railways had been judiciously constructed, and without extravagance, would sufficiently remunerate the undertakers, as such moderate principle of charging would bring the most traffic.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

May 31.—The President in the Chair.

On the construction of Model Maps, as a better mode than Sectioplanography for delineating the Drainage and Agricultural Improvements of a Country, or projected lines of Railways, Canals, &c." By John Bailey Denton, Assoc. Inst. C. E.

This communication was accompanied by a map in relief of an estate, as a specimen of the method which the author recommends. The subject of mapping in relief is not new, and the author had previously published a treatise on the subject, but having made extensive experiments, he was enabled to bring the subject before the Institution in a more defined form, showing that the construction of the models had been reduced to a simple and cheap method. These models are peculiarly recommended for pointing out the capabilities of a district for drainage either for agricultural purposes, or for collecting waters together for manufacturing power. They are superior to maps, as they show at a glance the relative heights of the various points, display the geological phenomena, and may be made to delineate the state of cultivation of the districts. The lines of railways, of roads, or of canals, can be more clearly defined upon them, and they are stated to be peculiarly adapted for parish surveys. The expense of making a model of an estate of compact form is stated to be from 2*s.* 6*d.* to 3*s.* 6*d.* per acre.

"*Observations on the Periodical Drainage and Replenishment of the Subterraneous Reservoir in the Chalk Basin of London.*" By the Rev. James Clutterbuck.

This paper, which formed the substance of a letter to the Reverend Dr. Buckland, and was by him communicated to the Institution, consists of a series of observations on the periodical drainage and replenishment of the subterranean reservoir of the chalk basin of London, especially that part of it which lies in a N. W. direction between London and the Chiltern Hills.

The author divides the district into two portions, that to the north and that to the south of the river Colne.

The northern portion is mostly covered only with a bed of gravel, through which the rain water percolates to the chalk, in which, being upheld by the retentive strata below, it accumulates until it finds vent by several deep valleys which incline southward, and carry off a large quantity of water by the streams Ver, Gade, Belbourne, and Chess, into the river Colne, which runs in a S. W. direction under the escarpment formed by the outcrop of the London and plastic clays.

The surface of this reservoir on the water level, regulated by these vents, dipping towards the south at an average inclination of nearly 300 feet in fourteen miles, may be represented by a line drawn from the upper district at an angle, and terminating at the river Colne.

The southern portion is almost entirely covered by the London and plastic clays, from the surface of which the rain water flows in open drains and water-courses. A considerable portion of that which flows towards the Colne, sinks into the subjacent chalk, when it arrives at the outcrop of the sand of the plastic clay formation, and assists in the replenishment of that portion of the reservoir that underlies the London and plastic clays. Here the water level, or the height to which it would rise through perforations in these clays, where its continuity is interrupted by them, would be represented by a line drawn from the Colne to mean tide level in the Thames below London, the only apparent vent for their waters. In the upper district during the replenishment of the reservoir, which usually occurs between December and March inclusive, the water accumulates in a proportion increasing with the distance from the river or vent, and falls off in a corresponding ratio during its periodical exhaustion, which usually takes place between April and November. This alternation of level, which in the upper districts exceeds 50 feet in perpendicular height, would be represented by a line fixed at the river or vent, and rising at an angle proportionate with the increase furthest from it, the extent of its rise or fall being determined by the quantity of rain percolating the chalk. The ratio between these extreme points is so exactly maintained, that if the difference of rise or fall in two wells, one near, and another at a distance from the vent be ascertained, the alternation in the intermediate wells will be determined with considerable accuracy.

The progressive rise of the water level is apparent at the sources of the streams which break out at higher levels in the valleys in which they run, or when brooks or burns burst forth and run during a certain period, when the surface of the reservoir attains a certain level, previously to which, the water rises in every depression till it reaches the height at which it can flow away; the converse of the effects which preceded their bursting may be seen as they cease to flow.

When no water percolates the surface of the upper district, the flooding of the Colne by heavy rains, together with the sinking of the water into the chalk at the outcrop of the sand of the plastic clay formation, raises the level in that locality, and by checking the drainage retards the exhaustion of the reservoir. When this occurs during the replenishment, and from continued rain the level near the river maintains an increased elevation, the water checked in its course towards its vent accumulates in a ratio increasing with its distance from it, a process of adjustment to be traced throughout the district during the replenishment, and conversely during the exhaustion of the reservoir.

The geological condition of the lower portion of the district, together with the paucity of wells, make it difficult to ascertain the extent of the natural alternations of that part of the water level which underlies the London and plastic clays; the difficulty is increased by an unnatural depression caused by the exhaustion of water under London, which is said to increase yearly, and indicates that the rapidity of the demand exceeds that of the supply: the alternation at that point may be from 2 to 4 feet, and is coincident with the rising and falling of the levels in the upper district.

If water be discharged from a shaft in the chalk by a power not capable of exhausting it entirely, the rapidity of the reduction of the level will gradually decrease until it is exactly balanced by that of the supply; when the exhaustion ceases, the level will rise in the inverted ratio of its reduction; if the level be measured in a line from the point of exhaustion, a similar reduction will be found, falling off at an angle decreasing with the distance from it.

The aggregate discharge of water from under London produces a similar effect: daily measurements in one well, confirmed by some coincident measurements in another more than a mile distant, show that beginning on Monday, the level is gradually reduced during the week; the cessation of pumping on Sunday is marked by the rising of the level by Monday morning; if any great quantity of rain falls, a sudden rise or check in the periodical fall takes place; the resumption of any extensive or continued discharge of water may be traced; a general coincidence of rise and fall in different wells is apparent; holiday times, such as Christmas, Easter, and Whitsuntide, may be distinguished. Thus, the measurement of a chalk well in London, would show the days of the week and the great festivals, by the daily variations; the seasons would be indicated by the average difference in the height of the level at different periods of the year; and the changes of the weather by the falling of the rain, would also be shown.

The chalk under London is of a much closer nature than that in the upper districts; it yields the water sparingly but steadily from orifices beneath those beds or bands of flint which are the most unbroken and the strongest, and from faults and cracks which are frequently met with. The constant and increasing demand not only depresses the level under London, but must accelerate the exhaustion of the reservoir above. When the water level near the Colne is suddenly raised by heavy rains, a simultaneous effect is produced on the chalk wells in London. This suggests the possibility of connecting a periodical defalcation of water observed in that stream, and the river Lea on Monday, at those seasons when the water is short, with the exhaustion of water under London. The courses of both these streams is somewhat similar with reference to that place, though they flow in opposite directions. There is some evidence in favour of this supposition, which may be established when more information is obtained, which will be best effected by keeping registers of the daily variations of wells in different localities, and determining the height at which the water stands with reference to Trinity high-water mark. Such information, if brought together, would well repay the labour bestowed on its collection.

The author's views were illustrated by a number of sketches and enlarged diagrams of the geological formation of the district, &c.

Remarks.—Dr. Buckland was desirous to bring the subject of Mr. Clutterbuck's paper before the Institution, because he was impressed with the value of a systematic series of observations upon a matter so intimately connected with engineering as the theory of the causes of the supply of water to springs and rivers, and the rise of water in Artesian wells.

In his Bridgewater treatise, pl. 68 and pl. 69, he had illustrated by diagrams the causes of the accumulation of a subterranean reservoir consisting of sheets of water diffused through strata of gravel, sand, and chalk within the basin of London, and of the rise of water in wells and small perforations through the London clay, under the influence of hydrostatic pressure.

Mr. Clutterbuck's observations and experiments confirmed the general opinion as to the existence of these subterranean sheets of water in the chalk basin, and indicated a connexion between their distant parts, by the sympathy he had observed between the sudden floods at Watford and certain wells in London, the level of which had been carefully observed and found to rise a few hours after the occurrence of the floods at Watford. In London also, he had confirmed observations already made upon deep wells at considerable distances from one another, and found that any large quantity of water taken from one well reduced the level of those adjacent.

It had been questioned whether the communication between wells of this kind took place solely through the medium of large cracks and fissures, or whether the entire masses of the permeable strata, beneath the level of the lowest springs which flowed from them, had all their pores and minutest interstices so entirely filled with water, that any abstraction of this fluid from one well was more or less rapidly replaced by a general flow towards it from every part of the water-logged stratum of sand or gravel or stone in which it was excavated; on the latter hypothesis during such a flow the surrounding wells would be affected in the direct ratio of their proximity to that from which large quantities of water were taken.

It had been found at Brentford that, as the number of Artesian wells increased, the force and quantity of each became diminished; a similar effect followed in the case of adjacent wells in London; the inference he would draw therefore was that a very extensive supply for the metropolis could not be obtained from deep wells of this kind, although a few wells might be supplied abundantly.

The district called the London Basin is made up of a continuous seam of chalk from 300 feet to 500 feet in thickness, which on the S.E. of the Colne is covered with beds of sand and gravel, alternating with plastic clay, and over all these, a thick covering of London clay: whilst the country N. and N.W. of the Colne is for the most part composed of naked chalk. Beneath the whole chalk basin lies a sub-stratum of clay or gault which is impermeable by water, and upholds the reservoir in question. The valleys in this chalk are traversed by the rivers Ver, Gade, and Chess, whose chief perennial supply of water is from springs that issue out of the chalk; in one of these valleys Mr. Dickinson had proved by experiments made with Dalton's rain-gauge (which, being buried 3 feet beneath the surface, received only such water as descended more than that depth) that during about two-thirds of the year the rain which fell rarely sank 3 feet into the earth; but in November, December, January, and February it passed down into the subjacent chalk, in proportions which accorded so constantly with the greater or less amount of rain falling in these four wet months, that he had been accustomed to regulate the amount of orders undertaken to be executed in his paper-mills during the following spring and summer, by the indications on this rain-gauge, of the quantity of water that descended more than 3 feet in the preceding winter.

The Colne is often flooded by the effect of sudden rain which is retained upon the surface of the London clay; but that portion of its water which is derived from perennial springs is supplied from the overflowings of the natural reservoirs, or subterranean sheets of water which fill the interstices of the chalk, and also of the sand and gravel beds of the plastic clay formation. The surface of this reservoir is marked by the outbreak of a succession of springs, at levels gradually rising as they are nearer to the upper regions of the chalk; and as the entire supply of this subterranean stock of water is derived from rain that falls on the surface of permeable strata within the London basin, the abstraction of water from any part of this reservoir would, Dr. Buckland conceived, diminish the quantity remaining to be discharged by springs into the rivers in the vicinity of such abstraction, by the total amount of water so transferred to any other than its natural channels.

It was asserted that the surface of the water in this subterranean reservoir did not maintain a horizontal level, but that it rose nearly 300 feet in fourteen miles, between the town of Watford and the highest spring that issued from the neighbouring chalk hills. The molecular attraction of the particles of chalk through which this sheet of water is diffused, and the obstruction presented by friction to its descent through the numerous pores and minute crevices by which it has to pass in adjusting the line of its upper surface, might account for this deviation from the level line which fluids assume, if left to act freely in open spaces, or in large and continuous conduits; Mr. Clutterbuck's repeated observations upon wells along the line in question must be considered to have proved the existence of this inclined level. His observations were also very important, as to the floods at Watford raising in a few hours the level of the water in deep wells in London, and as to the effect of a steam-engine erected to pump water from a large experimental well near Watford in lowering the water in smaller wells in that town and the country adjacent to it.

Mr. Dickinson had made very accurate observations upon the absorption of water by the chalk, and was convinced of its being always in a wet state almost amounting to saturation; but few crevices and fissures exist in the chalk of the district under notice, the rain therefore occupies a considerable time in overcoming the molecular attraction of the particles through which it passes. Wherever fissures exist at a certain depth below the chalk, they become channels which collect and facilitate the flow of water to maintain the springs; the accumulations of the winter rain sink slowly down in summer, and by a series of vents or springs furnish a supply for the rivers which run in the deepest valleys of the chalk district; a long cessation of rain lowers the level of the water in the rivers, at an interval of some months after the drought, and any extraordinary demand by pumping from the wells in the chalk, would lower the water in the wells around, even at a considerable distance.

From experiments with the rain-gauge buried 3 feet below the surface, he found that but little rain penetrated to that depth until the months of November, December, January, and February—the total quantity per annum was shown to vary between 17 inches and 6 inches, which latter amount sufficed to fill the principal springs. He was induced to believe that if a large supply of water was drawn from the chalk it would eventually have a prejudicial effect in diminishing the water in the rivers of the district.

Mr. Clutterbuck said that the sphere of his observations extended over a line of wells 20 miles in length, and in the whole of them there was the most perfect accordance between the alterations of level of the water and the indications of the rain-gauge, allowing the time necessary for the rain to sink into the chalk; as also there was between the fall and replenishment of the wells at Watford and those in London, whence large quantities of water were obtained by pumping; he could always tell, by measuring the height of water in one well of the series, what would be that of any other well along the line; he therefore was satisfied of the accuracy of the observations in his paper.

Mr. Dickinson observed, that he could not satisfactorily account for the greater amount of variation in the wells at the higher part of the district, when compared with those of the lower part; the alternations of the former amounting frequently to 30 feet, while those of the latter were only 10 feet in the same time.

Dr. Buckland believed this fact to arise from the hydrostatic pressure being less interfered with by friction and capillary attraction, in the lower part of the district than in the upper part.

Mr. Clutterbuck accounted for the alternations of level in the sand springs, being greater than in the chalk springs, by the relative degrees of opposition the water met with, from the friction in passing through the two kinds of strata.

Mr. F. Braithwaite had made many borings and sunk several deep wells into the chalk—he would instance particularly the wells at Messrs. Meux's and Messrs. Reid's breweries, and that at Greenwich Hospital; in these wells he had used cylinders of iron to shut out the sand springs. He did not find the chalk so spongy or saturated with water as had been stated; he imagined that the supply of water was derived from the crevices in the chalk, and in many instances water had not been arrived at, because one of these crevices had been missed, whilst in a well of less depth nearly adjoining, in which they had fortunately hit upon the crevice, a plentiful supply of water was obtained. In the first and second beds of flints under London there was very little water; from the third to the fifth bed the quantity increased, and at 30 feet lower down a continuous fault or crevice was generally found which conveyed a good supply of water—the rise and fall of water in wells in the chalk did not accord with those of wells in the sand beds above the chalk; the alternations in the former amounting to only a few inches in a given time, while those of the latter were as many feet. He placed great confidence in the observations made by Mr. Clutterbuck. That gentleman had told him accurately, from the variations of the well in the Hampstead Road, all the differences of the quantity of water drawn from Messrs. Reid's well, arising either from an extra demand or from cessation in the pumping. The brewers of London could be supplied by the water companies at a cheaper rate than by pumping; but as a large quantity was used for refrigerating the wort, it was important to have the water at a low temperature, they therefore were obliged to pump it up at a great expense. The quantity raised at Messrs. Reid's well was about 7,700 barrels of 36 gallons each per day, which was calculated to be a sufficient supply for 5,000 families; there was already a decided diminution manifested in the supply from the sand springs, and an extension of these effects might be anticipated from the sinking of any large number of wells into the chalk.

Dr. Buckland ascribed the difference of the supply of water in sand springs, and in those originating in chalk, to the relative extent of surface of the sandy and cretaceous strata in Hertfordshire, by which alone they receive their respective supplies of rain water, the amount of sandy surface being to that of naked chalk about as one to twelve.

The rain filters more rapidly through the sand than through the chalk. In beds of hard and compact chalk at great depths, the water sometimes finds no passage except through occasional fissures, but where the chalk is soft, loose and fragmentary, it percolates rapidly.

In the deep well now sinking near Southampton, through London and plastic clay into hard and solid chalk, it would probably be necessary to continue the boring or excavation down into some loose and more permeable stratum below the chalk, before any very large supply of water would be obtained.

Mr. Palmer directed the attention of the meeting to the account of the wells in the London Basin, given in Conybeare and Phillips's Geology (book 1, chap. iv. sect. 11.) It is there stated that at Tottenham, which is about 70 feet above high-water mark, after boring through 123 feet of clay and 2 feet of calcareous sandstone rock, the water rose to within a short distance of the surface in a few hours. At Epping, where the summit of the well is 340 feet above high-water mark, the extreme depth of the bore was 420 feet, but it was abandoned because no water was found; at the end of five months the water rose to within 26 feet of the surface and it has so continued, at 314 feet above high-water mark.

These recorded facts induced him to receive with much caution the statements in Mr. Clutterbuck's paper, especially since he doubted the ready flow of water through the chalk by which the sympathy between the various wells was demonstrated; he had found that chalk might be used as a good puddle for holding water, and therefore as it was certainly more compact when *in situ* than when it had been worked, unless the water flowed along the faults and the beds of flint, he could not understand how it passed so rapidly as had been stated. The chalk no doubt contained some water, but if it was saturated why did not the water in all the wells assume one uniform level instead of heights varying between 20 feet and 314 feet above high-water mark?

Mr. Clutterbuck contended that the main points of his statement were borne out by Mr. Braithwaite's experience at Messrs. Reid's well. A clear distinction must be drawn between the water derived from strata above the clay and that from the chalk; in some elevated spots near London, situated like Hampstead, the clay is capped with gravel, which on being tapped, yielded a supply of water; at Stanmore the water from the gravel at the top of the hill is used; and in a well sunk through the clay at the bottom of the hill, the water stood at 140 feet below the surface. He could not understand why at Epping there should exist any variation from the usual observed facts; the case deserved very careful examination, as it might arise from some local cause. In the course of his observations upon the levels of the wells in London, he found on one occasion that no depression occurred on the Thursday which had hitherto always been the case; he therefore sought for the cause, and found that the Elstree reservoir had been opened on Wednesday, June 1st, which satisfactorily accounted for what had occurred, as from the dry state of the water-course not more than half the quantity of water which passed from the reservoir, reached the river Colne, the rest sank through swallow holes down into the chalk; this showed the attention to collateral circumstances, which was demanded in investigations of this kind.

Mr. Frederick Braithwaite presented and explained a model of a well sunk by him in the year 1841 at Messrs. Reid's brewery, in order to obtain water from the chalk, which had become indispensable, in consequence of the decrease of the supply of water from the sand spring.

On examining the lower part of the well, which had collapsed in 1814, he found that the dimensions of the cast-iron cylinder to be introduced, must be limited to 5 ft. 3 in. by 3 ft. 2 in.; it was commenced at the depth of 87 ft. from the surface, and carried down 135 feet, to within 1 ft. 6 in. of the face of the first bed of flints in the chalk.

Being desirous of retaining all the water from the sand spring, he inserted an internal cylinder which was sunk into the chalk at a depth of 138 feet from the surface, thus effectually shutting out the sand spring from that of the chalk, but permitting the former to flow to its accustomed level in the space between the two cylinders; and to make this supply available in case of need, cocks were inserted in the internal cylinders at convenient depths.

He then proceeded with the excavation in the chalk, increasing the dimensions at every foot in depth, until at 178 feet from the surface, the diameter was 16 feet 6 inches; the excavation was continued at that diameter to a depth of 202 feet from the surface.

In the progress of the work, water was found under the second, sixth, eighth, and tenth beds of flints, and the total supply at this period was two thousand barrels or seventy-two thousand gallons per day of twenty-four hours.

At 196 ft. from the surface the first tunnel was driven 91 ft. N. W. in the direction of another well, which only increased the supply 400 barrels or 14,400 gallons in 24 hours.

The eighth bed of flints, at 154 ft. from the surface yielding the largest quantity of water, (300 barrels or 10,800 gallons per day,) he drove a second tunnel 6 ft. high by 5 ft. wide, for 16 ft. E. to W. and then N. and S. for 108 ft., by which he obtained an increase of 1500 barrels or 54,000 gallons, per day.

Having ascertained by boring, that a further supply of water could be obtained at 20 ft. below, he continued the excavation 22 ft. deeper by 7 ft. diameter, when he found water flowing from two horizontal fissures in the chalk without flints; at that depth he drove 2 tunnels, one N. W. connected with the first tunnel 91 ft. long, by which he obtained an increase of 3100 barrels or 121,600 gallons per day, the second tunnel in a S. E. direction was driven for 24 ft., when he obtained a further increase of 800 barrels or 28,800 gallons per day.

The total quantity of water thus obtained from the chalk, was 7700 barrels or 277,200 gallons per day of 24 hours, or 192 gallons per minute, forming at the same time a reservoir in the chalk which could contain 100,800 gallon.

He stated the total expense to be under £7000 including the hire and repair of temporary pumps, and the cost of two new sets of permanent pumps.

June 7.—The PRESIDENT in the Chair.

"*An Account of the Alterations to Tullow Bridge.*" By Charles Forth.

The old bridge at Tullow, over the river Slaney, was very dangerous from its steepness, its narrow roadway (only 18 feet wide) and the awkward approaches to it; alterations were therefore determined upon, for which the author submitted a plan and also superintended the execution of it. The floods forbade any diminution of the water-way, and it would have been inconvenient to have raised the approaches on the low banks on either side, flat arches of the following proportions were therefore decided upon.

	Span.	Versed Sine.	Proportion of Versed Sine to Span.	Diameter of Circle of which the Arch is a Segment.
	Feet.	Ft. In.		Feet.
Land Arch . . .	17	0 7	$\frac{1}{29}$	120
Second Arch . .	22	1 6	$\frac{1}{14}$	110
Centre Arch . .	28	2 3	$\frac{1}{13}$	110

The inclination of the roadway was thus reduced from one in seven to one in forty, while at the same time by adding to the abutments on the up-steam side, the width of the roadway was increased from 17 feet to 28 feet, and by completing a portion at a time, the thoroughfare over the bridge was not at any time stopped. For the sake of economy, the work was done in undressed rubble granite with an ashlar face, taking care that the stones abutted well against each other, and on removing the centres, no settlement of any importance took place, and the traffic of loaded cars weighing 35 cwt. each, was carried on without any danger, within a week from the time the arches were keyed. The expense of the alteration was only £485, and it has stood well although it has been subject to some heavy floods.

A detailed drawing of the bridge, before and after the alterations, accompanied the paper, and Mr. Vignoles sent with it an enlarged plan, section, and elevation for the purpose of more fully illustrating what he considered a successful work.

"*On the Introduction of Letter-Press Printing for numbering and dating the Notes of the Bank of England.*" By Thomas Oldham, Assoc. Inst. C. E.

The author commences by noticing the numbering press invented by Mr. Bramah, and adopted in the Bank of England in the year 1809, by which the expense and uncertainty of finishing annually a large number of bank notes, with the pen, was materially diminished, and forgery was rendered more difficult, although the machine was so far incomplete, that it produced only units, the tens and hundreds requiring to be brought forward by hand.

In that year (1809) the late Mr. John Oldham, (the father of the author,) offered unsuccessfully to the Bank of Newry, a machine similar in principle to that of Mr. Bramah, but with the additional power of effecting numerical progression, from one to one hundred thousand by its own operation. In 1813, these machines were adopted at the Bank of Ireland, and one of them was subsequently attached to each press for printing the body of the notes, in order to register and check the number of notes passing through the press.

In the year 1819, Mr. Bryan Donkin invented a counting machine, which is described in vol. 37 of the Transactions of the Society of Arts; it is called "a machine applicable wherever it may be desirable to keep an account of the number of revolutions or strokes, which may be made by the wheels or levers of any other machine, in a given time or space; as for instance, the number of revolutions made by a mill wheel, or of the strokes of a steam-engine beam in a given time, or the number of revolutions made by the wheel of a carriage or perambulator on passing over a certain space." This machine, like all the others used for a similar purpose, depended upon the relative motion of a series of ratchet wheels with projecting rims, having notches cut in them, so that when the first wheel counted units, the second wheel indicated tens and so on progressively.

The principle of these machines was carried out in a complex manner which required very neat adjustment to prevent their being deranged while working; the author after he succeeded his father as engineer to the Bank of England turned his attention to this point, and the result has been the production of the machine described in the paper.

Four wheels, each divided by 10 notches, leaving a facet between each, engraved with constructive numbers from 1 to 0, are placed upon a shaft, a portion of their breadth being turned down about one-half of their depth, having a boss or collar between each; upon these bosses and filling up the spaces, rest latches, and over each wheel is a pall, the width of the first being equal to that of the unit wheel, and the breadth of the others equalling that of the wheel and latch;—the palls are driven by a crank, by each revolution of which, the first wheel is moved through a space equal to one-tenth of its entire circumference, bringing regularly forward the numbers from 1 to 0, at which point, the latch of the second wheel is depressed, and the wheel moves forward one division, marking the tens; the same process is repeated with regard to the other wheels, and thus any amount of numbers can be registered, by simply increasing the number of the wheels in proportion.

Machines on this plan are now generally adopted in the Bank of England with perfect success, and in some cases they are added to the Bramah numbering machines; and as the author believed that they might be adapted to other purposes than Bank-note printing, he presented the drawings and description of them to the Institution.

June 14.—The PRESIDENT in the Chair.

"*On Iron Sheathing, broad-headed Nails, and Inner Sheathing for Ships.*" By J. J. Wilkinson.

These three papers complete the subject which the author commenced in the year 1841, and continued during the present session.*

The first treats of the use of beaten iron, and iron nails, even in very ancient vessels, their corrosion, and consequent abandonment; the attempted introduction of rolled iron for the purpose of sheathing. It touches lightly on the construction of iron vessels, and on various attemps to protect them, which experience has now shown to be unnecessary, as the first iron steamer built by Mr. A. Manby in 1821, at the Horseley iron-works, has been in constant use on the river Seine up to the present period, without showing any symptoms of oxidation, although the only precautions taken, have been to apply a coat of pitch, as often as to a wooden vessel. Extracts are then made from Mr. Grantham's treatise on "Iron as a material for Ship-building."† A list is then given of the patents connected with iron sheathing and the various modes of preserving it from corrosion, alluding particularly to the valuable labours of Mr. Mallet (of Dublin) on this subject in the archives of the Institution.*

The next division treats of metallic sheathing or a coating of metallic oxide, formed by driving broad-headed nails nearly in contact with each other, into the sheathing board; this process is called filling. The nails used for this purpose by the Romans, were of the same form as those of the present day. There are authentic records of "filling" being generally in use in this country in 1666—but it is conjected that it was practised much antecedent to that time, and it has continued in use until recently in Swedish and Danish ships. This mode of protecting the piles of harbours and piers from the ravages of the worm is then treated of, and examples are given of its success in various situations.

The third division treats of the inner coating or sheathing, which it has been found necessary to use, independently of the external metallic sheathing. It is stated, that some of the stronger and more adhesive kinds of inner sheathing, have proved mainly instrumental in preserving vessels from sinking, when the outer sheathing has failed or been destroyed.

Hair is noticed as among the earliest materials used for inner sheathing; it was usually applied in a loose state and fixed by pitch or other resinous substances; it was subsequently woven into and used as a cloth—the coarse part of flax was in the time of the Romans bruised and driven between the seams of their galleys. A vessel was discovered in the Mediterranean Sea (between the years 1458 and 1464) in a depth of water of 12 fathoms, where it is supposed to have lain for nearly 1400 years; the deck and sides were covered with paper, linen, and leaden plates. In all the oldest vessels which have been discovered the hair was perfectly fresh, although the timber was in a state of decay, and it is stated that the worm never penetrates through an inner sheathing of hair. In the year 1761, when copper sheathing was introduced, experiments were tried upon different kinds of paper for lining, and after trying white-lead and other substances, thick brown paper dipped in tar was found to be the best.

A list is then given of the patents for different kinds of "felt" now used for inner sheathing—noticing particularly that of Messrs. Borrodaile and Co. which appears to be that which is most generally approved. Cocoa-nut fibre and cork, and many other substances, which have been tried at different times, are noticed, and the paper concludes with a copious list of the experiments upon the subject, which the author has compiled from various sources.

"*On the Sinking and Tubbing, or Coffering of Pits, as practised in the Coal Districts of the North of England.*" By Robert Thomas Atkinson, M. Inst. C. E.

This communication describes the means usually adopted in the Northern coal districts, for effecting the "winning" of those valuable mines, and the author expresses the obligation he is under to his uncle Mr. Buddle, to whose valuable documents he had free access during the progress of his labours.

It commences with noticing the early periods of mining, before the introduction of steam power for pumping, when the extraction of coal was almost wholly confined to such tracts as could be drained by free water-courses, "adits," or levels; the chain and bucket pumps, and other limited and expensive means, are then explained, with the principles of free drainage, showing that it was generally only applicable to districts of small extent, and that the best mines were left untouched.

Steam-engines upon Newcomen's principle, were first used in the Newcastle district in the beginning of the last century, and they underwent many modifications, before they were superseded by the Boulton and Watt engines now generally used. The consequence of this introduction of steam power for raising coal, instead of accomplishing it by means of horse gins and other rude contrivances, is that the capability of supply appears only limited by the demand.

Over and above the weight of coal raised, it is necessary to draw immense quantities of water for the purpose of draining the mines. In some collieries the weight of water pumped up, amounts to as much as four times that of the coal raised. At the Percy Main colliery (which is rather an extreme instance) 3922 tons of water are pumped up daily, while only 636 tons of coal are raised in the same time. At the Benwell colliery, which is an average case, the weight of water amounts to 2020 tons per day, and the coals raised to 768 tons or 38 per cent. of the weight of water.

The principal technical mining terms in use in the northern districts, are then explained, and the author proceeds to describe the methods of sinking the shafts, noticing the difficulties which occur in traversing strata of various kinds, and the modes of overcoming them—the temporary timbering with "cribs" and "deals" previous to walling—and the different kinds of "tub-

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* Minutes of Proceedings, 1841, pp. 318, 357, and 360, Vol. IV, and 1842, p. 169.

† *Iron as a Material for Ship-building.* By John Grantham. Simpkin and Co., 1842. Pages 6, 7, 8, and 9.

"The first iron steam-vessel, and the first that ever put to sea, was built at the Horseley Iron Works, for the River Seine, and called the 'Aaron Manby,' after the name of the projector and builder. I have lately been favoured by Mr. Manby with the particulars relating to this vessel, which are very interesting as recording the origin of iron steam-vessels. He states in his communication, dated 19th February. 1842, that under a patent which he took out in France for iron steam-boats, in 1820, he, with his friend Captain (now Admiral Sir Charles) Napier, formed a society, and immediately began to construct the first boat at Horseley, but owing to some circumstances connected with the parties at Paris, she was not completed till the end of 1821. She was then sent to London in parts, and put together in the Surrey Canal Dock. She took in a cargo of linseed and iron castings and Captain Napier took charge of her, and navigated her from London direct to Havre, and thence to Paris, without unloading any part of the cargo, she being the first and only vessel of any description that ever went direct from London to Paris. Mr. Manby continues, 'Some time after, I built another iron steam-vessel of the same description, with a few alterations, at Horseley; but, owing to the navigation laws in France, she could not be admitted, and was obliged to be shipped in parts, and I put her together at Charenton, near Paris, where I had then established iron-works, and where I subsequently constructed two other iron steam-boats, the whole for the navigation of the Seine. They continued prosperously at work till 1830, when, owing to the Revolution, and some disputes among the shareholders, they were sold to a new society. In this new society I had no further interest, but they continued navigating up to the period of my quitting France, and I believe are all at work at the present time. From 1822 to 1830 the hull of the 'Aaron Manby' never required any repairs, although she had been repeatedly aground, with her cargo on board.'

"The next iron steam-vessel with which I am acquainted was one built by the Horseley Company, under my father's (Mr. Grantham, sen.) superintendence. This vessel was commenced about the year 1824; was put together in this port (Liverpool), and after a series of delays, crossed the Channel in 1825, and proceeded to her destination, Lough Derg, on the river Shannon. Since then she has been constantly at work, and is now in good condition.

"Shortly after this time, Mr. John Laird of North Birkenhead, commenced building them on a large scale, and has since been extensively and successively engaged in this pursuit. Mr. Fairbairn, of Manchester, also very early took an interest in iron-vessels, and was a party to a series of experiments made at Glasgow, in which iron vessels were employed.

"The 'Ironsides' was the first iron sailing vessel of any magnitude that was employed for sea voyages, and she has been highly successful. She has made three trips to and from South America, and fully realizes all the advantages proposed in her construction."

In a letter from Charles Wye Williams, Esq., dated Dublin, August 21, 1842, he says, "The old iron steamer called the 'Marquess Wellesley,' built for Mr. Grantham at the Horseley Works, is still working and in good order. I went in her recently through Lough Ree and some of the tributary streams that run into the Shannon,"—(SEC. INST. C. E.)

* Minutes of Proceedings, 1840, p. 387, Vol. III.

bing or coffering" of wood, stone, or cast-iron, used in passing wet portions of the strata or perishable rocks; this part of the subject is treated of very fully, with all the details of the construction of the different kinds and the methods of using them. The cast-iron tubbing, which was first introduced by the late Mr. Buddle, is particularly noticed, as is also its use in segments at the Percy pit in the year 1779; some instances are given of the decomposition of cast-iron tubbing and pumps, when exposed to the smoke of underground furnaces and the action of mineral water, the combined action of which has been found to reduce the metal to the consistency of plumbago.

The construction of the pumps, buckets, clacks, rods, &c. composing the apparatus for raising the water from the mines, is then fully described, with the "off-take joints" and the "fish-head" for drawing a "drowned clack." The "hanging sets" or columns of pumps, with their "ground spears" used in sinking the shafts, are also described, with the method of fixing the cisterns at intervals in the shafts, for the different sets of pumps, which are all of the "lifting" kind.

Accounts are then given of the sinking of Percy pit, Flatworth colliery, commenced in 1799—of Howden pit, Percy Main colliery, in 1804—and of a pit at the Barrow Field colliery in 1822, in all of which, great difficulties were encountered.

An explanation is then given of the extensive and complete set of sections of pits, drawings of the machinery, and of the models which accompanied the paper, and the author promises to extend the subject on a future occasion, as this communication is less comprehensive than was intended and has been sent in its present state for the purpose of complying during the session, with the usual condition of election.

June 21.—James Simpson in the Chair.

"*The History of the Canal of Katwyk, (Holland,) with a Description of the principal Works.*" By the Chevalier F. W. Conrad, translated by Charles Manby, Secretary, Inst. C. E.

This communication is divided into three parts:—1, The introduction; 2, The history of the Canal of Katwyk; and 3, A description of the principal works.

1. The introduction gives the general outline of the locality of this canal, which is probably one of the most useful and extensive works undertaken in Holland, for the purpose of draining the low lands and rendering them capable of cultivation; it is carried in a north-east direction from the village of Katwyk-binnen through the sand-banks to the North Sea, where it is terminated by five sea locks: it was undertaken for the purpose of draining the district called "Rhynland," a succinct account of which is given, with details of the early attempts at draining, such as the embankments of Marendyk, those of Spaarndam, &c., tracing them up to the time of Count William the Second, king of the Romans, in the year 1253; at which period the level of the district was identical with that of medium tide, and each "Polder" (or spot of cultivated land) was separately protected from the spring tides by an embankment; a change has occurred in the relative levels, whether by the sinking of the land or the elevation of the sea is, it appears, a subject of dispute, but it is certain that the level of the river Y and of the Zuyder Zee is now much above that of the Rhynland district. The natural consequence of this change, has been to increase the demand for artificial drainage by canals, and of windmills for pumping, and also the establishment of local boards of direction, whose duty is the superintendence of the works for the protection of the lowlands.

The district of Rhynland contains 127,000 bonniers or 317,500 English acres, which is thus divided:—

	Bonniers.		English Acres.
1. Polders, or Districts embanked and drained by windmills	54,831	=	137,077·5
2. Lakes and Peat-bog already laid dry .	15,262	=	38,155·0
3. Land without mills and sandbanks on the borders of the North Sea . . .	32,630	=	81,575·0
4. Lakes, Canals, Ditches, Peat-bogs abandoned, &c.	24,277	=	60,692·5
	127,000	=	317,500·0

The drainage is effected by 268 windmills, working scoop wheels or Archimedean screws.

Within this district, is included the Lake of Haarlem, which alone extends over 18,000 bonniers or 45,000 English acres; the drainage of it is now commenced and will restore a tract of very valuable land.

The enumeration of the original locks at Spaarndam and other places, is given, showing their incapacity for carrying off the waters, particularly when unfavourable winds prevented their free current into the Y, and hence the necessity for the canal of Katwyk and the choice of that particular spot, which is not affected by the prevailing winds.

2. The historical portion of the memoir, treats of the naturally unfavourable position of the district for drainage; it mentions a project for a canal at Katwyk in the year 1404, as related by Professor Lulofs,* on the authority of the historian Van Mieris; and enumerates all the various examinations of the levels, the projects of tunnels, canals, &c., the appointment of numerous committees, the local opposition to the several plans, the repairs of the embankments, which had become so expensive that the landholders abandoned their estates, rather than pay the cost of preserving them; the attempt to form a small canal through the sandbanks, which was either closed by a heavy storm or was suffered to fall to decay; the effect of the siege of Leyden by the Spaniards in 1573-4, when instead of draining the country, every attempt was made to cause an influx of the waters to annoy the invading army. It appears that subsequently the expense of renewing the hydraulic works would have been so considerable, that they were in a great measure abandoned for a time. In 1627, attention was again given to the subject, and Katwyk was pointed out as the only spot for an effectual system of drainage. The map by Bolstra, which the author promises to send, shows all the plans with great precision.

The reports are then given of all the various engineers and scientific men, on the drainage of the Lake of Haarlem, in all of which the Canal of Katwyk is a principal feature. The very able tract by Mr. Twent on the state of the drainage of Rhynland, and the necessity for a canal at Katwyk, is mentioned as one of the principal causes for its final construction. After the publication of this tract, Mr. Brunings, in the year 1802, caused the nomination of Mr. Conrad (the father of the author) and Messrs. Blanken, jun. and Kros, to report upon the project; which they did with such effect, that in May 1804, it was ordered to be executed by the reporters, under the superintendence of Mr. Brunings, the director-general of the "Waterstaat;" the plan selected being that which was laid down by Mr. Conrad. In August of the same year, the works were commenced, and in 1805 were so far advanced, that in June the first stone of the inner lock was laid: Mr. Conrad, who in consequence of the decease of Mr. Brunings had assumed the chief direction, carried on the works with such activity, that they were entirely finished by the month of October 1807, without the occurrence of any accident, although they had to support several very severe storms during their progress. On one occasion just as the masonry of the locks was finished the level of the tide was raised by a storm 2·36 metres (2·54 yards) higher than usual, carrying away the external cofferdam, but such was the solidity of the masonry that it resisted perfectly.

A steam-engine was fixed for pumping up a head of water for scouring the sand from the exterior canal; and the final opening of the canal took place with great ceremony on the 21st October, 1807, when a medal was struck to commemorate the event, a copy of which is given by the author to the Institution.

Mr. Conrad made a series of experiments which completely proved the efficacy of the works, and then was carried off within the short space of three months from the termination of his successful labours, which will hand down his name to posterity, as the projector and executor of one of the most useful engineering works on record.

A slight sketch is then given of the origin of the Lake of Haarlem, the causes of its extension, and the works already executed in anticipation of its eventual drainage.

The third part consists of a detailed description of the principal works at Katwyk, with their dimensions, and the necessary references to the drawings which accompany the paper.

The length of the canal from the Rhine to the sand-banks near the lock, is 2260 metres (2471·53 yards) of an average depth of 2·20 metres (2·40 yards) beneath the conventional height of tide for the kingdom of Holland, from which all tidal measures are taken; it corresponds with the average tides of the river Y; the common tide at Katwyk falls 0·60 metres (0·65 yards) below and rises 1·02 metres (1·115 yards) above that standard.

From that lock to the next, is 490 metres (535·86 yards) of the same depth; the additional canal is 1108 metres (1211·70 yards) long, the widths at the standard level vary between 13 and 40 metres, (14·21 and 43·74 yards) and the side slopes, which are all puddled and covered with turf, vary between 1 to 1 and 3 to 1.

The outer canal which has been made chiefly by scouring, is 151 metres (165·13 yards) long, to low-water mark, at a depth of 0·47 metres (0·5139 yards); below that point, it is 37·67 metres (41·19 yards) wide and the sides are constructed of fascines covered with stone.

The principal works enumerated are—

1st. The sea locks (buiten sluis.)

2nd. The interior lock (binnen sluis.)

3rd. A bridge of three arches at the sea locks, with balance gates and rising sluices.

4th. A bridge of two arches over the canal in the Noordwykerweg.

The five sea locks are each 19·78 metres (21·63 yards) long and 3·77 metres (4·12 yards) wide; with the mouths of the out-fall culverts 1·88 metres (2·05 yards) below the standard tide level. They are founded upon piles of red and white deal, with sleepers, and the whole faced and covered with deal plank sheathing.

The masonry of the foundations and of the principal part of the construction, is of blue limestone from Escosine, squared and well bedded. A hard stone called "klinkers" is also much used for ashlar work, and an inferior quality of stone for rubble-work, with bricks.

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* Lulofs' Treatise on the Elevation of the Sea and the Depression of the Land on the coasts of Holland, Transactions of the Society of Haarlem p. 1, f. 88.

The mortar used up to a short distance above the standard tide level, was made from stone lime, and above that, of lime made from sea-shells; cement was also used in several parts.

The modes of constructing these various works are given in minute detail; many of them, differing materially from the English method of construction, possess great interest; particularly those which relate to the embankments and the fascine work.

A description is then given of the Canal of Oegstgeest, which is a prolongation of the Canal of Katwyk for the purpose of bringing into the latter, the waters from the Lake of Haarlem; as well as a means of carrying off the waters of a portion of Rhynland, during and after the drainage of the lake.

In consequence of the establishment of this canal, the Canal of Katwyk required to be enlarged, which was done to the extent of rendering it 52 metres (56·86 yards) wide, with an average depth of 2·20 metres (2·40 yards) below the standard level. The bridges were also enlarged, and it is now contemplated to add two openings to the inner lock, those of the sea locks being already of sufficient capacity.

Having described the works in detail, the author enters into some general remarks upon the effect produced by the canal, one of the principal being its beneficial use in determining the possibility of draining the Lake of Haarlem. Thirty-five years of experience, have demonstrated that this canal is the surest remedy for the peculiar position of the district of Rhynland with regard to drainage; the constant action of the North Sea has made no impression upon the simple but solid masonry of the sea locks, in fact, the Canal of Katwyk appears to be one of the most remarkable hydraulic works ever constructed for the protection of Holland.

The author concludes the paper by stating, that although he could with difficulty spare the time from his professional labours on the Amsterdam railway, of which he is the engineer, he was induced to undertake the labour of drawing up this memoir, by the subject being one of those proposed by the Institution of Civil Engineers, in the list for Telford and Walker Premiums for 1842, and by the desire of doing justice to the memory of his father, whose early decease alone prevented his name from becoming as extensively known as his talents deserved.

The paper is illustrated by nine comprehensive drawings and charts, with some lithographic views, a portrait of Mr. Conrad, sen., and the medal which was struck on the occasion of the first opening of the sluices.

"*On the Construction of the Bridges on the Bolton and Preston Railway.*"

By A. J. Adie.

This paper, which was written at the request of General Pasley, and by him communicated to the Institution, contains a description of the bridges over the Cowlin Brook, the Lancaster Canal, and the Chorley Road, which alone possess any peculiarities of construction, and they formed the types upon which the other bridges were built.

In Colonel Sir F. Smith's report upon the Cowlin Brook bridge, he advised great attention being paid to the bridge on account of its "unusual slightness, and the badness of the ground upon which it was founded." The author states, that the latter circumstance induced him to design the present proportions of the work as he wished to reduce the weight of the piers as much as possible; he therefore ventured to deviate from the original design given by Mr. Rastrick. The result has justified his anticipations, as "after the most careful inspection not a single crack nor a splintered stone can be detected."

The ground where this bridge was to be placed, was found to be a rotten and compressible mixture of moss, decayed wood, and sand, with a few large stones; a foundation was made for each pier by driving in piles 20 feet long by 12 inches square; upon these were placed the footing courses of Limerick stone 8 inches thick; the piers were built hollow, so that the utmost weight placed upon each superficial foot should not exceed 5½ tons, which the author states to be a light load for ashlar work:—"In Edinburgh there are old rubble walls 34 in. thick and above 100 ft. high, which in addition to all their proportion of eight floors, and a roof, have 6¼ tons on each superficial foot of the bottom courses, and there is a brick chimney in Bolton, the bottom courses of which support 8½ tons on the superficial foot."

The bridge consists of eight arches, each of 30 ft. span; the arch stones are 18 in. thick, of hard sandstone from the Whittle hills, except seven courses at the crown, which are from a better quarry at Ackrington, near Blackburn.

The author then mentions, as a precedent for such dimensions, some arches constructed under Mr. Jardine's direction on the Edinburgh and Dalkeith Railway; they were of Craigleith stone, semi-elliptical in form, of 24 ft. span, with a rise of 4 ft., or ⅙th of the span; the stones for these arches were 12 in. deep at the springing, and 9 in. deep at the crown; the abutments of one of them are founded on platforms of timber, without piles, resting upon soft plastic blue clay; they have been standing for upwards of ten years, and exhibit no signs of failure. Another arch is also mentioned, constructed by the same engineer, over the South Esk, near Dalkeith, the span of which is 55 ft., and the versed sine 12 ft.; the keystone is 18 in. deep, and the springers 21 in. in depth.

The author objects to placing a mass of earth upon the haunches of the arch, as, from the tremour caused by the passing of the railway trains, the earth has always a tendency to be wedged in between the side walls and to force them out; he therefore left voids above the arch stones, allowing only sufficient weight of masonry upon the haunches, and thus securing the rapid hardening of the mortar; for this latter reason also the walls of rubble-work never much exceed 3 feet in thickness, and they have been found much stronger in consequence.

The railway is carried over this viaduct on longitudinal bearers, 13 inches deep by 6 inches thick, laid on planks 3 inches thick; the bearers and planks are not fixed together with a view to diminish the vibration of the passing trains: this method of laying is stated to be very effective in this respect.

The Lancaster Canal Bridge was originally intended to have been a direct span of 60 feet, constructed of iron, but the directors subsequently decided on building a skewed stone arch of 25 feet span on the right angle. The arch is semi-elliptical on the square, with a transverse axis of 41 feet 2 inches and a semi-conjugate axis of 8 feet 9 inches; the arch stones are 2 feet 3 inches on the square at the springing, and 1 foot 6 inches at the key-stone; the bed joints intersect at right angles all the lines of sections of the intrados, made by vertical planes, parallel to the elevation; and it is that property that causes the chamfer lines of the beds of the stones to diverge from the springing to the crown. These lines of the curved joints are easily laid down on the sheeting of the centres from a full-sized development, and by lines drawn at different heights, parallel to the springing of the arch. The lines of the radiating bed joints are always perpendicular to the tangent of an ellipse of the same form as the elevation of the bridge, the moulds used to form this being applied in the plane of the elevation. The twist on the length of the beds of the courses was taken from full-sized skeleton moulds of the form of the oblique ellipse or elevation. The five courses running parallel to the abutments are all of the same form and have the same amount of twist on the beds of each stone, except the end stones of the courses, which are varied in length to suit the general breaking of the joints of the courses resting together. The centre part of the arch is plain square work.

This mechanical method of finding the lines, and the twist of the radiating beds for an elliptical skewed arch, is destitute of the scientific accuracy of the mode by which Mr. Buck calculates his spiral lines for oblique bridges, of which the section at right angles to the abutment is an arc of a circle; but the workmen had no difficulty in putting it in practice, and the author states that he would have had more trouble in constructing trussed centres for a flatter curve of a circular arc, and at the same time keeping the towing path of the canal open. He states that he has not met with any description of an arch executed in this manner, but he considers it the only true principle. Every very thin section parallel to the elevation is a proper elliptical arch, and there is a very great saving of stone from the smallness of the twist on the curved beds as compared to the common method of working them.

The Chorley Road Bridge is a compound of the common and skewed arches, which the author finds convenient and economical. He has executed several upon this plan; they are as perfect as the best common arches, and free from skirting of the soffits of the stones. The section of this bridge at right angles shows a rise of 5 feet, with a span of 25 feet. The springers at this part are 15 inches deep, and the key-stone is 13 inches deep; on the oblique section, or the elevation, the span is 37 feet 9 inches, and the rise 5 feet; the springers are 24 inches deep, and the key-stone is 17 inches deep.

The straight part of the arch is formed with courses about 10 inches on the soffit, and these are turned round in curved lines which are portions of circles, the straight parts of the courses being then tangents, and they cut the lines of the elevations at right angles, so that there is no more tendency of the arch to sink at the elevation than would be the case with any elliptical segment of similar dimensions worked in the ordinary way. The part of the acute angle of the arch is formed with courses which converge from the elevation to the abutments, on account of being arcs cutting the elevations at right angles, and then becoming nearly tangential at the springing. The curves for these courses were transferred from the development to the sheeting, in the same way as those for the Lancaster Canal Bridge, and the twist of the beds was taken off full-sized sections of the arch, made in the directions of the converging lines of the extremities, so that at each of these places the beds were worked as if for part of a true elliptical arch, and the beds between the points thus formed were worked off with curved rules found from the development. After the masons got into the way of working this kind of arch, they of their own accord preferred it to the complete skewed arch. In brick work built in this way, it would be very easy to skew the ends of a long archway by having the bricks moulded to the curvature of the key-course, as with a very little alteration they would fit any part of the concentric courses, and a few tapered bricks would facilitate the filling up of the fan-shaped part of the haunch of the acute angle.

The communication was illustrated by several detailed drawings and a model of the bridge, with schedules of the prices and cost of the works.

DR. PAYERNE'S PURIFICATION OF FOUL AIR.

The notice taken of Dr. Payerne and his diving-bell experiments in the last number of the *Journal*, has elicited a long article in the *Times*, evidently from the same pen which recorded the performances of Dr. Payerne at Spithead. The tone of the article is, however, altogether different from the preceding ones, being rather apologetic than laudatory. Though the writer deprecates the manner in which we analysed the Doctor's performances, he tacitly admits that the result of our analysis is correct;—that nothing, in short, had been accomplished by the apparatus which might not have been done without it. This admission of Dr. Payerne's apologist formed the sum and substance of our remarks, the object being to guard against the adoption of any plans founded on such an unsatisfactory basis. We did not deny Dr. Payerne's power to purify air; we merely asserted that if he possessed such power, he had afforded no sufficient proof of its agency. The insinuation of charlatanry is censured by the writer in the *Times*, but he, at the same time, admits that such an accusation is partly justified by the foolish and absurd paragraphs published in the papers respecting the wonderful powers of a sub-marine boat proposed by Dr. Payerne for navigating the bottom of the ocean; and the writer seems particularly anxious to explain, that Major-General Pasley never sanctioned that peculiar plan of navigation.

Since our former article on this subject was written, we understand that some trials have been made of Dr. Payerne's apparatus in the purification of the air of mines. The experiments are briefly and unsatisfactorily recorded, but they are represented to have fully answered. If the invention be applicable to the purification of foul air in mines, the apparatus will be far more valuable than it could have been in its first proposed application for sub-marine operations; and the Doctor will deserve well of this country for his invention. We confess, however, to have misgivings of such a desirable result, and wait for further proofs. In the mean time, the secrets of the "box" begin to ooze out. The French Academy of Sciences, at some of their recent sittings, have had inventions submitted to them for the purification of air in diving-bells; and though Dr. Payerne's name does not appear in the reports, we imagine that the plans proposed and his are the same. It may be remembered that we before hinted the box might contain highly compressed oxygen gas. This seems actually to form part of the plan submitted to the French Academy of Sciences, but the ingenious inventors propose to use *oxygenated water* instead of oxygen gas alone. Absorption of gas, as well as its generation, is likewise contemplated; for it is proposed to absorb the carbonic acid gas expired from the lungs by caustic lime. If this constitute the whole of Dr. Payerne's secret, we conceive it will avail him nothing. The absorption of carbonic acid gas by caustic lime might possibly be effected on a scale sufficiently great to produce practical results; but unless there be invented some more ready and more economical mode of obtaining oxygenated water than at present known, no real advantage could be derived from the application of any such plan, either for the purification of the air in mines, or for sub-marine explorations.

We subjoin abstracts of the reports read to the French Academy of Sciences to which we have alluded:—

Sept. 26.—A communication was made by M. Thénard, on the means for remaining for a long period in a limited quantity of air, by the absorption of the carbonic acid gas exhaled, and the renewal of oxygen in proportion to its consumption. That the carbonic acid gas exhaled, and which, in excess, becomes fatal, may be absorbed by lime is a well-known fact, but as it is necessary, in the purification of air, to replace the oxygen, which is the vital principle, as well as to get rid of the excess of what is injurious, the great object to be attained in cases where, as in diving bells, it is important to make the same limited volume of air serve for several hours, is to produce oxygen with ease and certainty. M. Thénard proposes to employ oxygenated water, and has shown that not less than 475 times the volume of water of oxygen-gas may be compressed in this vehicle, and subsequently liberated as required. But to produce this result, great care and expense are necessary, and, when obtained, the difficulty of preventing the escape of the oxygen, when not wanted for immediate use, is also very great.

Oct. 3. A communication from M. Sondalo was read, on the means of purifying the air which has been already taken into the lungs from the carbonic acid gas with which it is charged. This gentleman informs the Academy that he remained under water an hour, clothed with a waterproof dress, and having with him, in a small vessel, the preparation of lime required for the absorption of the carbonic acid and the oxygenated water, in order to renew the oxygen of which the air already breathed had been deprived. With the aid of this small apparatus, contained within his dress, he was able, during the time above stated, to purify the air which he took down with him.

[Since the above was in type and as we were closing the *Journal* we received a communication from Dr. Payerne, commenting on our strictures of last month; we regret that it arrived too late for insertion in the present number, it shall however appear next month.]

THE ECCLESIASTICAL COMMISSION.

[In another part of the Journal we have inserted a letter from a Correspondent respecting the conduct of the above commission towards the architects; since then we have procured a copy of the report from which we give the following extracts.]

The commissioners have agreed to certain regulations respecting grants towards providing houses of residence. They are as follow:—

Grants towards purchasing or erecting houses of residence will, for the present, be made only to meet benefactions from other sources, except in cases coming within the third class, and under other special circumstances.

All benefactions must be paid to the commissioners before they can enter into any arrangement either for purchase or for rebuilding.

Every house proposed to be purchased must be surveyed by the architect of the commissioners, and every new house must be built according to his designs and under his exclusive superintendence, the commissioners entering into the necessary contracts.

Plans approved by the commissioners have been transmitted to the several archdeacons, diocesan registrars, bishop's secretaries, and chapter clerks, with a request that they will allow them to be inspected by the clergy; and the plans may also be seen at the office of the commissioners.

Before a contract for building is entered into, reasonable variations in these plans may be allowed, to meet local or other peculiarities; but no extensive deviation from the general design of the commissioners will be permitted, nor any alteration which is calculated to entail additional expense upon succeeding incumbents.

In meeting benefactions towards providing a house, a general rule of proportion will be observed, by which a house built according to the plans of the commissioners (painted, papered, and fitted with grates, bells, &c.), being about £900, the benefaction required will be about £450 in cases of public patronage, and about £540 in cases of private patronage.

"BRITISH ASSOCIATION OF ARCHITECTURAL DRAUGHTSMEN."

The formation of an institution for affording relief to distressed architectural draughtsmen, and for ameliorating the conditions of that class of artists generally is an object which would command our best wishes, and particularly when we see so laudable an effort as the formation of an annual exhibition of architectural drawings conjoined with it; but we are not prepared to admit that the plan now proposed is the best for carrying the object into effect. The rules are too much on the trades-union system to agree with the respectability of the body in question. An annual dinner is doubtless a very good thing, but we do not approve of one levied by fines on the members at large; neither do we think that a dinner is the most appropriate time for our artistic exhibitions. We should, therefore, recommend the abandonment of the whole penal code, the adoption of a more suitable period than August for an exhibition, and an extension of the plan so as to include engineering draughtsmen. The whole system of management must also be revised, and the names of the managers published, and with such amendments, we have no doubt that the plan being well meant will meet with the strong support it highly merits.

Belgian Railroads.—Brussels, Oct. 21.—M. Noel, Inspector of bridges and highways, has visited the whole section of the railway from Courtray to Tournay. Though the buildings are not finished, the road may be opened to the public on the 23rd of October. The Minister of Public Works will be present at the opening. For the present there will be only two trains in a day from Tournay to Brussels, and *vice versa*. With respect to the section of Turcoing, it seems that a trial will be made on the first 10 days of November, and that the inauguration will be on the 15th, when the King has promised to be present. The French trains have arrived at Lille; there is therefore nothing to prevent the trains from immediately beginning to run; but the French train at present takes only passengers, and no goods. The section of St. Saulye will probably be opened about the same time.

REVIEWS.

Article "THEATRE," *Penny Cyclopædia.*

Since our last notice of this publication, one or two other interesting architectural articles have appeared in it, and among them, that of "Temple," which, if it does not contain much upon the subject that can be said to be new, treats it so as to give it considerable freshness, and brings forward many remarks that we meet with for the first time. Were it only on account of the table which accompanies it, that article conveys a good deal of information not to be obtained elsewhere. What architectural articles of this class are introduced at all into other encyclopædias, are for the most part exceedingly meagre, and little better than mere compilations—taken at once from the most accessible source that first presents itself, apparently without any further research, and with very little previous study of the subject itself. As to the general execution of the Penny Cyclopædia in its other departments, we do not pretend to offer an opinion, but we will say—and that without fear of contradiction, that its architectural articles are both more numerous, and more instructive than those in similar works—a remark which is, perhaps, almost superfluous, after the extracts we have given from those on "Portico," "Spire," "Staircase," &c. Many articles of architectural biography have likewise been introduced, which are not to be met with in any other English publication—not even in those which are professedly biographical ones—such as Rodriguez, Quaglio, Temanza, Tessin, &c. Were there nothing else to stamp the articles in the Penny Cyclopædia, many of them are rendered more than ordinarily valuable and useful by communicating a great deal of information in a condensed tabular form, which is an exceedingly convenient one for reference and comparison. And although such tables amount to little more than compilation, it is such as requires considerable research and diligence, and shows that no trouble has been spared to render the articles as complete as may be, by collecting together into the briefest possible compass what is scattered about in fragments, and through a great number of volumes.

The article THEATRE is certainly not one of the least interesting of those relative to architecture which have appeared in this Cyclopædia, for it affords a clearer insight into the subject than has been done anywhere else; and sets in a very forcible light the vast difference between the system of the ancient and that ot the modern theatre and stage, in favour of which last the writer most expressly decides. The arguments for so doing are tolerably cogent ones, and must, we think, carry conviction to all who are not thoroughly blinded by their classical prejudices; at any rate it will be for those who dislike what he says as to the defects of the dramatic performances of the ancients, to refute it by proofs to the contrary. The very circumstance of their taking place in the open air, and by daylight, must, as he observes, have proved more or less injurious to scenic illusion, as far as such illusion was at all attempted, for at the utmost there could have been no very great degree of it. The permanent architectural scena or façade at the back of the stage, is tolerably satisfactory proof that there could have been no *scenery;* and even what is said in regard to the magnificence there displayed, chiefly shows how extravagant and preposterous such decoration must have been. In fact Pliny's description—if description it may be called—of the scena of Scaurus' theatre is hardly credible: when he tells us that it was ornamented with no fewer than 360 columns, and 3000 statues, we think that either he himself *Munchhausenizes* very cutrageously, or that some such small mistake as that of turning tens into hundreds and thousands, has been committed by the copyists of manuscripts. Besides, as that theatre was merely a temporary one, and was taken down again long before Pliny's time, he could speak of it only from hearsay, nor does he appear to have been at all deficient in credulity, and an appetite for the marvellous. Could the matter be sifted, it would probably turn out to be just such another story as that of St. Ursula and the *eleven thousand* virgins—a little inaccuracy arising from mistaking the name *Undecimilla* for a numeral to that amount. Not content with drawing upon our belief so largely in regard to his forest of columns and mob of statues, Pliny further assures us that the middle part or second order of the scena was of glass! His words are "ima pars scenæ e marmore fuit, media e vitro, inaudito etiam postea genere luxuriæ, summa e tabulis aurætis." Wonderful, however, as it is, he neither doubts, nor allows any one else to doubt this strange statement. He neither gives us the slightest authority for it, nor attempts to offer any explanation, but relates it in the most laconic manner possible, just as if it were a self-evident fact. What kind of authority then, we ask, is Pliny himself, for he seems to have swallowed with greedy gullability all the incredible stories he could pick up? Scaurus' theatre was after all merely a temporary structure, how then came Pliny to be so well informed as to the exact number of columns and statues? or knowing so much, how happened it that he knew no more, and could not explain how they were disposed, or how room could possibly be found for that enormous number; or again, what was to be understood, or what he himself understood by the expression "*media è vitro?*" Does *Vitrum* here mean glass at all?—or had not Pliny himself taken a *glass* too much when he was writing that passage? And how comes it that the name of the architect who contrived such a truly astonishing work has been nowhere recorded? Admitting Pliny's account, however, to be true, it is not very credible, because so exceedingly vague and obscure, that it is impossible to understand or make anything out of it. Nevertheless, it is from such vague hints and surmises, that modern antiquaries have formed their ideas of the magnificence of the ancient theatres, and that not only in regard to the edifices themselves, but the stage itself and its apparatus, and whatever enters into the system of dramatic representation. Not so the writer in the Penny Cyclopædia; since so far from affecting to admire the ancient theatre, he dwells at some length upon its great and numerous defects, and upon those of the stage itself. For what he says on that head, however, we must refer to the article itself, from which we quote nothing relative to the ancient theatre than the following list of some of the principal ones now known.

	Diam.	Orchestra.
Anemurium	197 feet.	
Aspendus	400	25 rows of seats.
(scena Ionic and Corinth.)		
Athens, Theatre of Bacchus	250	72 ft.
„ Odeion	90	36
Cnidus	400	
Delos	175	
Dramyssus, or Joannina	440	78
Ephesus	660	240
Epidaurus	370	55
Herculaneum	180	16 rows of seats.
Hierapolis	346	100
Laodicea, Great Theatre	364	136
Limyra	195	not known
Mantineia	227	not known
Miletus	474	224
Myra	360	120
Nicopolis (in Epirus)	360	120
Orange (scena only remaining, 336 ft. wide, 114 ft. high.)		
Patara	265	96
Perga		25 rows of seats.
Phellus	400	Scena 150.
Pola, about	200	68
(destroyed 1636, but plan preserved by Scamozzi)		
Pompeii	190	62
Pompeiopolis	212	138
Rome, theatre Marcellus	517	172
Sardes	395	162
Selinus (in Cilicia)	114	
Sicyon	313	100
Side	390	120
Sparta	453	217
Stratonicea	390	106
Syracuse	440	
Tauromenium	330	width of scena 132
Teos	285	70
Tralles	540	150

"Of some of these theatres scarcely anything remains, little more than their general shape and extent being now distinguishable; accordingly the statements of their dimensions are not to be strictly relied upon, though they are sufficient to enable us to estimate their comparative size."

In what is said on the subject of modern theatres we meet with many useful hints, and other information, and shall therefore venture to borrow pretty largely from that part of the article, where after specifying many faults and disadvantages in olden structures of the kind the writer proceeds to say—

> Very great reforms have now taken place, yet there is still room for further improvements, obvious, though not likely to be adopted so long as it is considered a matter of course that the space before the curtain must be made to contain as many persons as can possibly be packed into it, and that an audience must be piled up around the whole house to the very ceiling. We do not say that modern theatres are too lofty; the error does not lie there, but in carrying up the boxes, tier after tier, to such a preposterous height that the uppermost box is several feet above the top of the curtain or stage-openings, and the back seats of the upper-gallery are actually on a level with

the ceiling over the pit. Such accumulation of diminutive stories gives a crowded appearance to the whole, and leaves no space for architectural decoration around the upper part. No doubt a very striking appearance of a different kind presents itself from the pit and from the stage, when the house is entirely filled to the very top; and if we consider merely the coup-d'œil from such points, it may be allowed to be imposing. But then, as regards that part of the audience who occupy the upper part of the house, the arrangement is bad. From the seats which are at all above the level of the top of the curtain, there is only a bird's-eye view of the stage and the scenery, and that only from the front seats, and also facing the stage, for from those on the side of it it is impossible at that height to obtain a sight of the scene or even the actors, unless when they come forward towards the foot-lights. There should be no seats at a greater height than midway that of the curtain, or the level of what is now the second tier of boxes in our large theatres; for, as the scenery can be painted only to one horizon—generally that of the stage itself—its perspective effect is more or less impaired when it is seen from either very much above or below that level. No less preposterous is the practice of continuing the side-boxes up to the proscenium, and sometimes (as in the Opera-house at London) quite up to the very curtain, so that there is no proscenium at all, unless the space on the floor of the stage, between the curtain and foot-lights can be so called. While those so seated lose the scenery altogether, they have the disadvantage of seeing between the wings on the side opposite them; and although the positive inconvenience resulting from such arrangement is felt only by a portion of the audience, the bad effect occasioned by it extends to the whole theatre. Not only ought there to be a distinct proscenium, serving as an architectural frame to the stage and its scenery, dividing that part of the theatre from the rest, but it ought to be of much ampler proportions than are now given it. It should extend so far as to leave some interval—a sort of neutral ground—between the curtain and the boxes, so as to remove the nearest spectator in them to a tolerable distance for properly viewing the stage as a picture; for it is possible to be as inconveniently near the stage as distant from it. Where, in order to contract the stage, or to render the pit and general diameter of the house considerably greater than what is required for the width of the curtain, the plan is made to approach a circle (as is the case in nearly every theatre built within the last 20 years), the boxes should be confined to the semicircle facing the stage; and, so far from being a blank, the curved space on each side between them and the curtain might be made to contribute very much to the architectural appearance of the whole house. This would not take away any thing from the pit, and if it materially diminished the number of the boxes and seats in them, it would be only where there aught to be nothing of the kind. The banishing of boxes from such situations, and making also no more than two tiers, would certainly greatly abridge the present capacities of theatres; a house of the same size would not contain the same number of persons as at present, when a large part of the audience are put where they cannot well see the performance. It is likely, therefore, to be objected that such a system would be too expensive, since a large house would be requisite for a comparatively moderate audience; but curtailments might very well be made elsewhere, for at present the whole building is frequently very much larger and more costly than actual necessity requires, the "house" itself, be its dimensions what they may, taking up a comparatively small area of the entire plan, while the rest is occupied by stately approaches and saloons, which, where economy rendered it expedient, might be greatly abridged, and much plainer in style, and some of them omitted altogether as superfluous appendages.

In some of the modern continental theatres, the pomp displayed in such accessory parts of the building far exceeds anything of the kind in this country. In that at Berlin, besides several other spacious apartments, is a music-saloon 38 ft. high, 44 wide, and 106 ft. in length in its upper part, where there is a screen of 6 Ionic columns at each end; the whole highly decorated, and forming one of Schinkel's richest pieces of interior architecture. The theatre of Münich has two staircases to the boxes, with flights of marble steps 13 ft. wide; and besides two saloons for the public (each 82 × 31 ft.), there is a very magnificent one communicating with the royal box—not a mere ante-room, but what would be termed a noble room even in a palace, its dimensions being 46 × 44 ft., and 25 in height. In both these theatres, and in that of Genoa, the royal or state box is itself a room of some size, about 15 by 18 ft., more or less; and according to the general custom of the continental theatres, this box (which occupies the height of two tiers, and is adorned with caryatides in front) is directly in the centre of the house, facing the stage, consequently in the very best situation of all; whereas the situation assigned to royal visitors in our theatres is almost the very worst, as far as seeing the stage and the performance is concerned.

In regard to the form of the "house," a decided improvement has taken place of late years; and the circular plan, or one approaching to it (either extended by the curtain being a tangent to the circle or somewhat beyond it, or reduced by the curtain intersecting and forming a chord to the segment), may now be considered the one established as being the most pleasing and commodious—that which is best adapted for affording a distinct view of the stage to the majority of the audience. But there is considerable difference of opinion as to its being the best form in regard to hearing. In fact, the science of acoustics is not yet brought to exactness as regards practical purposes in building: it is easy enough to ascertain beforehand how much of the stage will be visible from different parts of the theatre, but not so what will be the result as to sound, since that will depend upon a variety of circumstances, some of them counteracting each other, and not every one of them to be guarded against or foreseen. The shape of the house is but one of them out of many: much will also depend upon size, much upon the depth of the boxes and galleries, and also upon accidental and such trivial matters, that any defect of advantage so occasioned is not likely to be traced to them. Here the chief guide is experience; and experience seems at present to be in favour of, at least not at all against, the circular form; for the new theatres at Mayence, Dresden, and other places where it has been adopted, are said to be perfectly satisfactory in regard to the actors being distinctly heard in every part.

The article concludes with a table of modern theatres, drawn up on the same plan as some of the other very useful tabular synopses attached to previous architectural articles in this Cyclopædia, and from which we have occasionally borrowed. In the present instance we must content ourselves with a small portion, namely that section of the table which relates to Germany and Belgium.

GERMANY AND BELGIUM.

	Architect.	Date.	Width of curtain.	From Curtain to Back of Pit.	Greatest Breadth of pit.	Height from Floor of Pit.	Stage.	
Berlin, Opera-house	Von Knobelsdorf	1740-3	26	64	42	58	50 deep 52 wide	An insulated building, 214 × 78 feet. Principal front, Corintnian portico, hexastyle monoprostyle, on low basement.
„ Great Theatre	Schinkel	1816	43	62		44	66 deep 86 wide	A magnificent structure, with Grecian Ionic hexastyle portico on a lofty flight of steps.
Dresden	Semper	1837-1841						
Hamburg	Schinkel	1826-7	40	69 to back of boxes	50	56	60 deep 80 wide	Plan of auditory nearly circular, *i.e.* a circle of 66 feet diameter, to which the curtain is a tangent. Four tiers of boxes, and amphitheatre formed by a colonnade of 22 pillars.
Mannheim	Ant. G. Bibbiena		30	46			71 deep	
Mayence	Moller	Fin 1833	54	74		60	56 deep 80 wide	Insulated, about 250 × 140 feet, with semicircular projection, 140 feet diameter on one of longer sides or façade.
Münich	K. von Fischer	Open 1818	39	78	62	64	91 deep 94 wide	Burnt Jan. 14, 1823; restored 1824-25. Octastyle Corinthian portico, including boxes, the auditory, a circle 72 feet diameter, between which and curtain is a space of 9 feet. Five tiers of boxes.
Wolfenbüttel, in the palace	Ottmer	1836-7	28	44 including boxes	29	27	36 deep 56 wide	Private theatre, fitted up in Gothic style, but detail in poor taste.
Ghent	Roelandt	1837-9	37	59	42		60 deep 78 wide	Façade 300 feet. Oval saloon 91 × 59, making, with smaller saloon and concert-room, an extent of 270 feet.

Electrotype Manipulation, Parts I and II. By Charles V. Walker. Tenth edition.

This little manual, published by Messrs. Knight and Sons, contains a most complete account of the whole process of electrotype manipulation, so that by its instructions any novice may become a proficient in this interesting art. The first part is devoted more particularly to the reproduction of medals. It enters largely into the consideration of those difficulties which may be expected to present themselves to the unexperienced, and states clearly the modes by which they may be avoided. The second part of the work relates to the more general applications of electrotype in the arts, particularly those of plating, gilding and etching. The directions are given minutely and clearly, and with a view to conduct the experiments by the most economical means. We have seldom, indeed, met with a work professing to give instructions in the manipulation of any art or process of manufacture so pratically useful as this small volume.

Gas Meters—their Unfairness Demonstrated. By Henry Flower. London: G. Mann, 1842.

This pamphlet explains the construction of the gas meter, and in what manner it may be affected so as to show a false register of the quantity of gas consumed, to the great loss of the consumer.

"An undue quantity of water in a meter will make a difference of about 20 per cent. in the amount registered over the quantity actually consumed, but let the water in a meter be ever so nicely apportioned, still the consumer will sustain a loss of something like 10 per cent.

"Blame, therefore, attaches both to the consumer and to the Companies, but more especially to the latter, It is not to be supposed that the consumer can enter into the niceties of a complex machine like a meter. The Gas Companies take good heed that the meters shall not and cannot give more than a nominal thousand feet for the thousand feet registered, which my experience shows to be not nine hundred feet for "the thousand," but they leave theirtenants to run the risk of defrauding themselves out of from 1 to 20 per cent. of gas as well. If, as the companies construct their meters, that too little water in them will occasion an impossibility of obtaining a supply of gas, why should they not be so gauged as to declare to the consumer, that if he has above a certain quantity of water in his meter, that he is registering water as well as gas?"

At the conclusion, Mr. Flower explains Mr. Lowe's ingenious plan for napthalising coal gas, which appears to be an invention of great importance.

A Series of Diagrams Illustrative of Mechanical and Practical Philosophy and their Practical Application. London, Chapman and Hall, Part III. (Published under the superintendence of the Useful Knowledge Society.)

The present number, which illustrates the wheel's axle, has shown several practical applications of that power. For instance, we have toothed gear, the crane, friction bands, and a circular saw. Thus, a more mechanical turn has been given to the work, and we can anticipate that it will in its progress form a portfolio of working drawings of all the principal machinery and mechanical applications, suitable for the mechanics' institutions and the workshops, and for instruction in all our colleges and academies; for such views its value is much increased.

Professor Hosking, of King's College, is preparing for publication "Professional Notes on some of the Flemish and Rhenish Churches, made during a recent tour in Flanders and Germany, with notices of the Belgian and Prussian Railways, and of the railway works now in progress between Liege and Aix-la-Chapelle"—and he has in the press, a work "On the Principles and Practice of Architecture, with Remarks on the modern practice of Competition."

THE VARIATION OF THE COMPASS.

Observations made at the Royal Observatory, Greenwich.

G. B. Airy, Astronomer Royal.

Mean Magnetic	Declination.	Dip at 9 A.M.	Dip at 3 P.M.
	° ′ ″	° ′	° ′
1842. July	23 17 14	68 34	68 39

THE TEMPLE CHURCH.

The restoration and repair of the Temple church, at once the most beautiful and perfect memorial of the Order of Knights Templars now in existence, cannot fail to be a subject of congratulation to the country at large. It is pleasant to reflect that beneath the surface of this bustling and money-loving world there is a strong undercurrent of enlightened feeling respecting the care of our national edifices. The ancient abbey of St. Alban's, Crosby Palace, and Our Ladye's Chapel, Southwark, are among the more recent structures preserved from decay by the honourable and ready contributions of subscribers from all ranks of society. The expense and magnificence of the repairs in the Temple Church promise to surpass any similar attempt in this country, the whole of the enormous outlay required being jointly borne by the two societies of the Inner and Middle Temple.

Those persons to whom the Temple Church was familiar in its late dress of plaster and whitewash will scarcely recognize the ancient structure in the gorgeously decorated appearance it now presents. The repairs were commenced in 1840. The dilapidated state of the building, in great measure owing to the reckless manner in which the walls and pillars had been overlaid with heavy monuments, rendered these works necessary, and, in accordance with the improved taste now prevalent in the public mind, the benchers were led to extend the mere repair into a restoration of the building as nearly as possible to its original state. The architect who commenced these works was Mr. Savage, but owing to some differences between that gentleman and the building committee of benchers, the charge was transferred to Mr. S. Smirke on the part of the Inner Temple, and Mr. S. Burton, on that of the Middle Temple. It is, however, due to Mr. Savage to state, that the plans prepared by himself have been in a great measure carried out by his successors.

The Entrance Porch is for the most part new, the excessively ornamented old doorway having been partly renewed, and the remainder reworked and restored.

The Circular Nave.—The six clusters of old Purbeck marble columns, which formerly supported the whole superstructure, have been removed and new columns of the same material substituted. The ceiling of the centre part (a truncated dome of comparatively modern erection) has been taken down, and a new oak vaulted and grained ceiling substituted, painted by Mr. Willement, strictly in accordance with the style of the period. The whole of the walls, arches, and aisle vaults have been reworked, and new polished marble shafts substituted for the old columns. The sculptural figures of the Knights Templars have been restored in the most perfect manner, and will again occupy their former positions.

The Triforium of the Nave has been converted into a depository for nearly all the monuments which formerly disfigured the walls of the church. This gallery, common in all cathedral edifices, now forms a handsome promenade of 12 feet wide and 15 feet high round the circle, the mural tablets of most of the eminent lawyers of the last two centuries being carefully arranged on either side. They are much better seen than formerly, and form an interesting collection of monumental sculpture.

The Square Chancel.—This part of the church, hitherto filled with pews, which concealed the bases of the marble columns (themselves hidden by a thick coating of plaster and paint, through the over-anxious desire to efface all emblems of the Popish faith on the part of the Protestant lawyers shortly after the reformation), and encumbered to a height of eight feet from the ground with oak wainscoting, shutting out the view of the elegant marble piscina on the south side of the building, has been entirely cleared of these unsightly additions. The huge pulpit and organ screen are also removed, and a new and elegant gallery for the reception of that instrument has been erected on the north side, occupying one bay, with a vestry beneath. The walls of the latter small apartment are studded with monuments, among which the most conspicuous are those of Lord Eldon, Lord Stowell, and Oliver Goldsmith. The north and side aisles are each divided into five compartments; the eastern division will be occupied by the benchers ladies, and that adjoining by the benchers themselves, every seat having distinct and elaborately carved elbows. The two next are occupied by the barristers, and the remaining division by the barristers' ladies. The members of the Inner Temple will occupy the south, and those of the Middle Temple the northern side of the church. The whole of the centre is fitted up with sittings for the students, in the cathedral style of arrangement. The most prominent object on entering the chancel from the western porch is the triple-lancet window over the altar. This beautiful specimen of stained glass, executed by Mr. Willement, F.S.A., is intended to represent the principal events in the life of our Saviour.

The prevailing colours used for the decoration of the walls and roof of the chancel are blue and red. The ceiling is divided into compartments, alternately ornamented with the armorial bearings of the two Inns. Figures of several of the early kings of England are emblazoned on the western wall, and the shield of the holy cross worn by the Knights Templars is frequently introduced. The altar is entirely new, from the design of Mr. Smirke. The creed and commandments are painted black, on a gold ground, with illuminated initials, producing a remarkable richness of effect. The whole of the designs for the stall-ends and elbows, consisting of grotesque heads and foliage of the most elaborate description, have been furnished by Mr. Cottingham, of the Waterloo-road.

The floor is paved with glazed encaustic tiles, copied exactly from ancient examples.

The bell, which was formerly in the roof of the circular nave (although that was not its original place), has been removed, and hung in a new stone belfry turret erected over the Newell staircase on the north side.

THE NEW ROYAL STABLES AND RIDING-HOUSE AT WINDSOR.

These extensive buildings have just been completed (the sum expended having been brought within the amount of the Parliamentary grant of £70,000), according to the original designs of the late Sir Jeffrey Wyatville, under the immediate superintendence of Mr. Ashton, his successor. Messrs. Grissell & Peto were the builders employed.

The buildings (the architectural style of which is in perfect keeping with that of the Castle) are on the south side of, and about 150 yards from, the Royal residence. The whole frontage, towards the Home Park, extends to upwards of 300 feet. The stabling and coach-house department occupies three large quadrangles, quite distinct from each other being divided by high stone walls.

Accommodation is afforded, in the aggregate, for 102 horses (exclusive of 13 loose boxes) and 36 carriages.

In the angles of each quadrangle are extensive forage lofts, constructed with every regard to convenience. Each quadrangle contains extensive saddle and harness-rooms, cleaning-rooms, and other appropriate and necessary offices, with water laid on throughout, large coppers for heating water, extensive dung-pits, and other appurtenances. The harness-rooms, which are heated by stoves, are about 20 feet square. The cleaning-rooms are of rather larger dimensions. The coachhouses, which are very lofty, are heated by means of hot air. Some idea may be formed of their dimensions, when it is stated that the extent of room appropriated for each carriage is 8 feet in the width, and 20 feet in length. An apparatus for heating water for the use of the men, and for warming the coach-houses, &c. is attached to each quadrangle and situated in the basement, with pipes communicating to every part of the building where it will be required.

The width of each stable, from the back of the manger to the opposite wall, is 22 feet—thus allowing plenty of space for the men behind the heels of the horses. Each of the stables, which are ventilated by means of an admirable contrivance, through an aperture leading to the roof (and which can be opened or closed at pleasure), will be lighted at night by gas. The whole of the flooring is composed of Dutch clinkers. In the centre of each stall are iron gratings, communicating with cross drains which run into the heel drains, under the flooring of Dutch clinkers, and through these, by merely turning a tap at the upper end of the stable, a strong course of water is forced, cleaning every accumulation away from the under drains into the common sewer to the river.

The poney stalls, the partitions of which are exceedingly massive, and constructed of highly polished oak, are 13 feet long and 6 feet wide. The stalls (the same material being used for the partitions throughout the stabling department) for the carriage and riding-horses are a little larger. The fronts of the mangers, and also the walls at their backs, extending 4 feet in height, to the top of the hay-racks, are of slate. The front upper edges of the mangers consist of a revolving cast iron roller, about 3 inches in diameter, extending their whole length; thus offering an insuperable bar to the practice of crib-biting.

The new riding-school, as has been before observed, divides the upper or northern quadrangle from the centre one. This spacious building is 170 feet in length, 52 feet in width, and nearly 40 feet in height. At night three splendid gas chandeliers along the centre of the building diffuse a clear and steady light throughout the interior. Over the riding-school are most convenient dormitories for the use of the single men connected with the stables; these consist of 30 apartments.

ST. GEORGE'S CHAPEL ROYAL.

This beautiful chapel was re-opened for divine service on Sunday morning, 23d ult., after having been closed for some days to enable the workmen to complete the large west window, and another of stained glass in the choir. The following description of the former window will enable the reader to appreciate more justly the alterations:—

In the year 1774, the Rev. Dr. Lockman, canon of Windsor, collected, from various parts of the chapel, a great number of detached figures in stained glass. These were placed in the compartments of the great west window, on a ground of plain white glass. The number of figures not being sufficient, however, to fill the whole of the openings, the glazier ingeniously composed some trellice patterns, which were formed in colours of the most discordant kind, to fill the remainder. The ramifications of the arched head were occupied by plain surfaces, chiefly of glaring orange and purple-stained glass; yet, with all these violations of good taste, perpetrated at the expense of the then chapter of 600*l.*, there was a certain degree of effect produced, particularly at sunset, which gave great brilliancy to the architecture.

In the new arrangement by Mr. Willement, the whole of the ancient figures have been repaired, and instead of the crude ground of white glass, on which they were placed, each compartment has a dispered ground of a warm yet quiet tint, with an architectural frame to each, formed by a base, columns, and enriched canopy, corresponding in design with the style of the chapel. Ten ancient figures, and as many entirely new, have superseded the formal and patterns of the glazier. The lowest range of openings being considerably higher than the others, that space is now occupied most appropriately by a long label inscribed with the prayer, "God save our gracious Sovereign, and all the Companions of the Most Hon. and Noble Order of the Garter."

Within the arched head of the window the four principal compartments are filled by the initials, crown, and badges of King Edward III., the founder of Order of the Garter; of King Edward IV., who began the erection of the present chapel; of King Henry VIII., who completed it; and of Queen Elizabeth, in whose reign so many additions were made to the Castle. The smaller openings are strewn with the Tudor devices on rich grounds of ruby and garter blue; in the centre, above a sculptured panel of the Royal arms, are placed in stained glass the arms of the patron saint, with the initials of Sanctus Georgius; and above these, in the extreme apex, the sacred monogram I. H. S. By these judicious alterations, the whole surface of the window has become replete with the richest tints, sufficiently varied to obviate any monotony, and producing, with the greatest fullness of tone, an entire absence of that unseemly glare which too often pervades almost all modern attempts in this class of art. The arrangement conduces essentially to develop the great beauty of the stonework—a point most sadly neglected in most cases.

Dorsetshire.—The roof of St. Mary's Church, Wareham, having been found about two years ago to be in a very decayed condition, and the accommodation being inconvenient, and the pews cold and damp, the rector and churchwardens had it surveyed by Mr. Donaldson, who ultimately furnished drawings for rebuilding the body of the church, providing accommodation for 1000 persons, 600 being devoted to the poor. The tower and chancel, which are fine specimens of simple ecclesiastical Gothic, still remain, and the church has been executed in the same style to accord with them. The new body consists of a nave separated from the lateral aisles by three octagonal piers on each side, surmounted by lofty arches, above which rises the clerestory with its ceilings to the height of 40 feet above the pavement of the nave. The church was re-opened for public worship on Michaelmas-day, the Bishop of Salisbury and a numerous body of the clergy assisting on the occasion. Some very curious fragments of a very old date, possibly as remote as the Saxon times, were dug up or discovered worked up in the old walls, and have been carefully preserved as memorials of the antiquity of the sacred edifice, which must have been built and rebuilt three or four times.

Architecture on the Continent.—In speaking of Cologne Cathedral, the *Athenæum* observes that something of the same spirit of reparation and restoration and completion of ancient monuments, which has set these vast works in progress, is diffusing itself very generally over the Continent. Our readers have learnt how actively this taste for the renewal and perfection of historical monuments has been engaged in France; and Belgium has not been behindhand in the work of restoration. The two towers of Sainte-Gudule, at Brussels, have been carefully repaired, and all the delicate tracery which time had injured has been renewed, stone by stone. The church of Notre Dame de Finisterre is surrounded by scaffoldings, which announce extensive repairs. So with the light and graceful spire of the Cathedral at Antwerp, "whose 622 steps" it is said, "may now be ascended, and the upper gallery reached, without the adventurer fearing to be carried away by the wind, in company with some decayed and tottering pinnacle." In the same structure, M. Geerst is still labouring at the Gothic stalls, which are said to be master-pieces of their kind. At Ghent, the Cathedral of Saint-Bavon is in course of complete restoration. At Bruges, the churches of Saint Salvador, of Nôtre-Dome, and the chapel of Saint Basil, have been repaired; and the venerable Cathedral of Tournai, the most ancient religious monument in Belgium, has, for upwards of a year, been the subject of important works intended at once to strengthen it and restore its ancient character. The Hotel-de-Ville, of Louvain, unequalled for the delicacy of its fretwork and tracery—a gem without rival in the florid-Gothic style, has also been carefully restored—and the Hotel-de-Ville of Brussels is now in course of restoration.

St. Martin's Church.—The steeple of this church, which was struck by lightning about three months ago, and suffered such extensive damage as to render it necessary to be taken down, has just been rebuilt, and was on Tuesday, the 10th ult., finally completed. The contract was undertaken by Mr. Hemming, of Regent Street, for the sum of £1000., which included the taking down of the old steeple and the building of the new one, and which sum will be paid by the Phœnix and Sun insurance-offices, by whom the church was insured about four years ago. The ball and vane on the summit have been regilt, and present a very showy appearance.

Bologna.—*Academy of Fine Arts.*—The programme has been published by the Academy of Fine Arts for the competition for 1843. We merely give the subject proposed for Architecture. Designs for a Custom-house on a great scale, for a large city. Besides the elevations of the building, there must be given, on a larger scale, separate drawings of the principal parts, and a clear account of the artist's views as to the disposition of the whole.

Rentals of Metropolitan Commissioners of Sewers, North of the Thames.—Westminster, &c., commission, £2,788,190; Holborn and Finsbury, £1,316,013; Tower Hamlets, £888,596; City of London, 792,904; Poplar, £78,411; St. Katharine's, £12,964. Total, £5,877,078. The city of London having sent in no return, the above amount is taken from their return to the House of Commons in August 1834.

Bricks lighter than Water.—Some bricks made of a clay of a portion of the soil of Berlin, which, on account of the quantity of fossil infusoria contained in it, will float in water.

ELECTRO-MAGNETIC RAILWAY LOCOMOTIVE.

A trial of this very ingenious machine, constructed by Mr. Davidson, was made last month on the Edinburgh and Glasgow Railway, in presence of a number of gentlemen, many of whom were eminent for their scientific knowledge. The construction of the carriage is the first attempt which has been made in this country to apply the powers of electro-magnetism to railway traffic, and from the success which attended this trial, sanguine hopes may be entertained that the period is not distant when it will either supersede, in many cases, the employment of steam, or lend a powerful aid to this mighty instrument in all the operations in which it is at present employed. The carriage was impelled along the railway about a mile and a half, and travelled at the rate of upwards of four miles an hour, a rate which might be increased by giving greater power to the batteries, and enlarging the diameter of the wheels. We understand that the carriage was built at the expense of the Railway Company, and we cannot but congratulate them in having the discernment to employ Mr. Davidson, a gentleman of much practical knowledge and talent, to whose genius great discoveries have been made in electro-magnetism, by whom the carriage was projected, and to whose unwearied exertions the practicability of the scheme is almost placed beyond a doubt.

The dimensions of the carriage are 16 feet long by 7 feet wide, and is propelled by 8 powerful electro-magnets. The carriage is supported by four wheels of 3 feet diameter. On each of the two axles there is a wooden cylinder, on which are fastened three bars of iron at equal distances from each other, and extending from end to end of the cylinder. On each side of the cylinder, and resting on the carriage, there are two powerful electro-magnets When the first bar on the cylinder has passed the faces of two of these magnets, the current of galvanism is then let on to the other two magnets. They immediately pull the second bar until it comes opposite them. The current is then cut off from these two magnets, and is let on to the other two. Again they pull the third bar until it comes opposite, and so on—the current of galvanism being always cut off from the one pair of magnets when it is let on to the other.

The manner in which the current is cut off and let on is simply thus;—At each end of the axles there is a small wooden cylinder, one-half of which is covered by a hoop of copper; the other is divided alternately with copper and wood (three parts of wood and three of copper). One end of the coil of wire which surrounds the four electro-magnets, presses on one of these cylinders, on the part which is divided with copper and wood; the other end of the coil presses on the other cylinder in the same manner. One end of the wires or conductors which comes from the battery, presses constantly on the undivided part of the copper on each cylinder. When one of the iron bars on the wooden cylinder has passed the faces of two magnets, the current of galvanism is let on to the other two magnets, by one end of the coil which surrounds the magnets, passing from the wood to the copper, and thereby forming a connexion with the battery. This wire continues to press on the copper until the iron bar has come opposite the faces of the two magnets, which were thus charged with magnetism. On its coming into that position, the current is cut off from these two magnets, by the wire or rod of copper passing from the copper to the wood, and thereby breaking the connexion with the battery. But when the wire or rod of copper leaves the copper on the one cylinder, it leaves the wood, and passes to the copper on the other cylinder at the other end of the axle, and in so doing connects the other two magnets with the battery, and they pull the next iron bar in the same manner. At the other end of the carriage there are other four magnets and wooden cylinder, with iron bars arranged in the same manner.

The battery which is used for propelling the machine is composed of iron and zinc plates immersed in dilute sulphuric acid, the iron plates being fluted so as to expose greater surface in the same space. The weight propelled was about six tons.—*Edinburgh Evening Journal.*

IMPROVEMENT IN SHIP BUILDING FOR STEAM NAVIGATION.

A most ingenious model has fallen under our observation, of which Captain Drew (the destroyer of the piratical Caroline) is the inventor, for strengthening ships of war, so as to make it all but impossible they shall become hogged. To steam-vessels of the larger class the adoption of this simple and comparatively inexpensive machinery will prove of most vital importance. The immense weight of the engines requisite for a steam-ship render her more than ordinarily liable to break amidships. Captain Drew's plan was, we are told, suggested by the ingenious and admirably effective operation lately performed on the Penelope.

The grand feature of his project is to relieve a steam-vessel from the vast weight of machinery amidships, and to throw it upon two distant parts of the ship, much more capable of sustaining it; and if there be any one vessel to which such an adjunct will be more especially necessary than another, it is the Penelope, whose machinery will be placed exactly in the space occupied by the 60 ft. of timber which remains to be added to its length. Captain Drew's plan consists of two longitudinal pieces of timber firmly trussed together, constructed on something like the principle of the arch of a bridge, which will be capable of bearing an immense weight. These bearers are to be covered by a platform for the machinery of four-inch plank; so that the strongest part of the vessel will, in future, be that which has hitherto proved the weakest. It is well known that the unfortunate President was broken-backed before she left the British Channel on her last trip, from the immense weight of her machinery amidships—the undoubted cause of her melancholy catastrophe. The owners of the British Queen are, we are told, about to cut her intotwo, for the purpose of avoiding a similar catastrophe. And it is well known that the long steam-vessels running in Canada seldom last more than 5 or 6 years, from the same cause. If, therefore, Captain Drew's plan should realize the expectations we have formed of it, it cannot fail of proving of most vital importance to the navy at large, and to steam-ships in particular.

We had almost forgotten to notice another important advantage that will be gained by Captain Drew's plan. The circumstance of the machinery being placed upon a platform that will be, to a certain extent, elastic, will obviate in a great degree that constant jar which is so trying to the timbers of a steam-ship, and so inconvenient to its occupants.

We have the greatest pleasure in speaking of this invention as we think it deserves, inasmuch as we have understood that Captain Drew has no interested motives in placing it before the public. He seeks no patent, and desires no reward beyond the credit of being instrumental in preserving not only valuable property, but human life, from destruction.—*United Service Gazette.*

STEAM NAVIGATION.

The launch of the "Prince Albert" Iron Steam Ship took place on Friday, the 30th Sept., at Mr. Coutts's yard, at Newcastle. The following are her proportions:—Length between perpendiculars 155 ft., length over all 180 ft., main breadth 19 ft. 6 in., depth of hold 9 ft. 6 in., draught of water when light with machinery 3 ft. 6 in., and when loaded with passengers 4 ft. 6 in. The ribs or frames of this vessel are formed of angle iron, 4 in. broad on the web, placed 2 ft. apart, and the thickness of her plates are three-eights, five-sixteenths, and one-fourth in. respectively. She has four longitudinal kelsons 14 in. deep, ¼ in. thick, with 8 cross kelsons of the same size of plate; the whole of these kelsons have strong angle iron fixed on their upper edge and riveted to the ribs and plates of the vessel, thus forming the bottom into a level platform of great strength, on which the engines and boilers are placed. There are other parts of the Prince Albert novel in their construction, such as the iron deck beams and gunwhale stringer, the former is formed of plate ¼ in. thick and 8 or 9 in. deep, with a piece of angle iron on each side to which the deck deals are attached by screw bolts; these beams form a diagonal knee at the sides of the vessel, and are attached to every alternate rib, forming one of the strongest and lightest beams yet constructed. The iron gunwale stringer is formed of plate ¼ in. thick, and from 9 to 11 in. broad, with a flange turned downwards, and covering the plates of the vessel to which it is riveted, and another flange on its inner edge, turned upwards and let into the waterway or covering board; this stringer is fixed down to the ribs and beams of the boat, and will form one continuous horizontal knee from stem to stern. The covering board is of pitch pine, 3 in. thick and 14 in. broad, bolted down to the gunwale stringer, and forming with it a very strong protection from accidents or damage by collision with vessels or otherwise. The deck deals are only 4 in. wide, and are tongued with iron hoop let in, with white lead in the grooves so as to preclude the necessity of caulking or pitching the joints. There are two iron water-tight bulk-heads, forming the vessel into three distinct compartments. The lines or model of the boat are considered by judges to be laid down on the most scientific principles; and altogether she forms one of the finest specimens of scientific skill and mechanical arrangement of marine architecture that we have witnessed. And should her machinery prove equally complete and efficient, which, from the manner Mr. Coutts speaks of it, we believe will be the case, the Prince Albert will be one of the fastest boats yet started on the Thames. The Prince Albert will be towed to London to receive the engines which are made by the owners, Messrs. Braithwaite, Milner & Co. The boilers are of Spiller's patent tubular, somewhat like locomotive boilers, with this difference, that the water circulates through the tubes instead of the fire. They were made and put on board the boat here by Mr. Coutts, and are said to be capable of generating sufficient steam for 130 to 140 H. P. in a space of about 7 ft. in the length of the vessel.—*Newcastle Paper.*

Naval Experiments on the Defences of Steam Boilers.—A highly interesting experiment was tried at Portsmouth last month, on board the Excellent gunnery-ship, Captain Sir Thomas Hastings, to test the efficacy of the defences of the boilers in steam-ships of war. One of the greatest difficulties to surmount, in order to render the steam navy of greater efficiency in action, is to afford adequate protection to the boilers against the shot of the enemy, as a ball perforating them would at once place the vessel *hors de combat.* With the view of affording this protection to the boilers, several war steamers have been fitted up with extra defences at the parts where the boilers are fixed. These defences consist of 15 plates or layers of metal, each ⅜ inch thick. The object of the experiment on board the Excellent was to ascertain what resistance these defences of boilers would offer to a cannonade at point blank distance, which is 400 yards. An iron target was prepared, made exactly of the material which constitutes the protection of the boilers of a steamer, and placed at the distance of 400 yards from the ship, from which guns at different calibre were fired at it. Admirals Sir E. Codrington and Parker, and a great number of naval officers, including those from the Austrian frigate, were present to witness the experiment. The first shot that was fired was an eight-inch hollow shot, and was projected from a 68-pounder, medium gun. It struck the bull's-eye, or centre of the target, and, slightly indenting it to the depth of about 5 in., rebounded therefrom, and was split into several pieces by the concussion. The second shot was a solid 32-pounder, and was fired from a gun of 9 ft. 6 in.; it struck the edge of the target, glanced off, and was split into two pieces. The third shot hit the centre of the target, where it lodged, having penetrated several plates. The fourth shot struck the third, and sent it clean through all parts of the iron, splitting it into numberless pieces, which were found on the off-side of the wooden stage on which the target was fixed. The fifth and sixth shots went through the perforation made by the third and fourth. About 10 other shots were fired, all striking the target in various parts, and completely destroying it. The result of this experiment has shown how totally inadequate are the present defences of the boilers of war steamers to protect them from the assaults of the enemy where a precision of fire had been attained.—*Times.*

Sale of the Great Western Steam Ship.—On Monday afternoon, the 11th October, at two o'clock, the steam ship Great Western was offered for sale by public auction in Bristol. The bidding was very spirited, but she was ultimately bought in at £40,000.

Royal Navy.—The launch of the "Cumberland" 70-gun ship took place last month on the anniversary of the glorious victory of Trafalgar, at Chatham dockyard. Her dimensions are as follows:—Length on gun-deck, 180 ft.; for tonnage, 143 ft. 5½ in.; extreme breadth, 54 ft 3 in.; for tonnage, 53 ft. 6 in.; moulded, 52 ft. 9 in.; depth in hold, 22 ft. 4 in. Her tonnage is as follows—burden by the old rule, 2,244 tons 40 lb.; new rule, 2,055 tons 88 lb. Her armament—lower-deck, 4 guns, 8 in. in diameter, 65 cwt., length 9 ft.; ditto, 22 guns, 32-pounders, [illegible]6 cwt., length, 9 ft. 6 in.; middle-deck, 2 guns, 8 in. in diameter, 65 cwt., length, 9 ft.; ditto, 26 guns, 32-pounders, 50 cwt., length, 9 ft.; quarter-deck, 16 guns, 32-pounders. 39 cwt., length, 7 ft. 6 in., and poop. The light draught of water of the Cumberland is, afore, 13 ft. 4 in., and abaft, 17 ft. 9 in. She broke (as it is technically termed) in launching 1½ in. She is not a particularly elegant craft, but is well calculated for the shallow water of the north seas.

MISCELLANEA.

Remedy for Broken Axles.—M. Huan submitted to the Academy of Sciences his invention for preventing accidents on railways by the breaking of the axle, which consists of a modification of the wheel of the locomotive, that if the axle should break, the wheel itself becomes an axle! and prevents further accident.

Electricity of Whirlwinds.—M. Arago, in allusion to the opinion expressed by several persons on this subject mentioned to the Académie des Sciences, some observations, made by M. Hortola on a storm, on the 24th ult., in the department of the Aude. This gentleman relates that on the occasion referred to, the iron bars of windows, the gutters of sheet iron, the plates of insurance companies, and other metallic objects were carried away by the whirlwind, thus indicating the presence of electricity.

Oscillatory Movement of the Sea.—The Academy of Sciences of Naples having charged M. A. Nobili to inquire into the circumstances connected with the oscillatory movement of the sea in the Gulph of Naples, it appears that he has studied the variations of the mean level according to the direction of the wind, and has found that the greatest elevation of the mean level takes place in the west-south-west winds, and the smallest in those of the north-north-east. This is also the case on the western coast of Sicily. M. Chazallon has also taken some observations on the tide at Toulon, from which it results, that the full tide of the evening is much higher than that of the morning.

Improved Fowling-piece.—M. Matthieu, a Frenchman, has invented a gun which, immediately after it is discharged, recocks itself, and a new charge is conveyed in the direction of the barrel. This is repeated five or six times. and with such rapidity, that the gun can be discharged five times in three seconds. If the sportsman does not wish to fire with this rapidity, he can stop the action, and wait any time he pleases between each discharge. The combinations of the mechanism are such as to prevent accidental explosion. This invention is not new. Baron Heurteloup, more than two years ago, produced a fowling-piece and a musket on this principle, and, according to report, he has made such improvements that double the number of charges of M. Matthieu's gun may be fired in almost the same space of time.

The Galvano-plastic Process.—A proposition has been made by M. Corney to employ this process after embalmment, for the preservation of the human body after death. The idea, however extravagant it may appear, is said not to be original, and that beautiful specimens are to be seen of small animals, birds, insects, &c. which have been thus preserved by M. Soyez, of the Place Vendôme.

The Green Park.—The site of the house and grounds of the late ranger has been levelled, new foot-paths laid out, and the whole thrown into the park, and it is now open to the public. The projected widening of Piccadilly from Devonshire House to Hyde Park Corner, is deferred for the present, as an act of parliament is said to be required.

St. Paul's Cathedral, which has been closed for some months, has been thoroughly cleansed, and is now re-opened. The old oak panellings and carvings of the choir have been varnished, the seats and pulpit covered with new cloth, the monuments purified, and the interior generally cleared of the accumulated soot and dust of years, so that the whole has a comparatively cheerful appearance.

The Artesian Well at Grenelle.—The new tube is now completed to the surface. M. Arago is of opinion that when the tube, beyond the opening of the well, shall have been carried to the proposed height of 33 metres, (108 feet), and the force of the rush of water have been thus diminished, it will become quite clear. It appears that the new tube, which has been introduced into the well, does not reach to the bottom; a portion of the former tube, which could not be extracted, has forced its way transversely, and prevented the end of the new tube from penetrating as far as was intended.

Mr. Jeffrey's Cement.—Some further experiments have been made in the marshes at Woolwich. A block of wood submitted by Mr. Jeffrey was bored to the centre, exactly in the middle of the joining, and a 5½ inch shell inserted, for the purpose of tearing it to pieces. On a port-fire being ignited, the shell soon exploded, tearing the solid wood in all directions, and into numerous fragments, but in no part separating the pieces where the joining with the cement was made.

Caoutchouc Cement.—M. Vallé, a colour maker, observing the injury caused to the works of some of the greatest masters by the influence of the atmosphere upon the canvas, has invented a solution (said to be of caoutchouc) which, although applied to both sides of the canvass, leaves it sufficiently elastic to prevent cracking, and secures it against the action of the atmosphere. To this he adds a peculiar kind of varnish for the painting, which is said to defy the ravages of time.

Survey of the Skies.—A survey of the skies was made on Monday, the 11th inst. in all parts of the kingdom, on a plan arranged at the last meeting of the British Royal Society of Agriculture, for the purpose of ascertaining the form and position of the clouds in the morning, at noon, and in the evening, together with a great variety of other facts respecting the force and direction of the wind, the state of the thermometer and barometer, and other meteorological appearances and phenomena. The object of this extensive survey was to collect facts respecting the weather, for the guidance of practical agriculturists.—*Globe.*

National Museum of Artillery, Madrid.—This museum has been removed to the Palace of Buen Retiro. It is now under the active direction of Don Leon Gil de Palacios, a distinguished artist and antiquary. The wrought iron cannon made by the Carlists in Biscay are described as of great merit. Some ancient cannon from Andalusia are to be added. Among the objects of curiosity are the armour of Garcia Paredes, the lance of the Empecinado, the sabre of Torrigos, the knife of Manzanares, the uniform of Morelas, the founder of American independence, and the lance of Leon. It has been suggested that the Museum of the engineers and the Royal Armory be united to the Museum of Artillery.

Electrical Experiment—In the course of experiments instituted by Messrs. Wright and Bain for the improvement of their electrical telegraph, they discovered that the electric circuit of a galvanic battery is as effectually completed through a large body of water as through an insulated wire. They have applied this curious discovery so effectually as to be now able to dispense with two of the wires heretofore thought necessary for the action of their printing telegraph; and they are thus enabled to print all communications, either verbal or symbolical, at any distance, by the use of a single wire. We understand they are now in treaty with the government to construct a telegraph on this principle between the admiralty and Portsmouth. One insulated wire would be laid down between the two points, to connect the galvanic battery of the outport with the printing apparatus of the Admiralty, and the return current would be sent through the earth, in lieu of using a second wire to complete the circuit. Should the moisture in the ground not prove sufficient to conduct the electricity, the inventors propose to transmit the return current by water; making it pass down the Thames to the German Ocean, and thence along the Channel to Portsmouth; this roundabout voyage to be performed instantaneously. By thus simplifying, and consequently greatly reducing the cost of the electrical printing telegraph, the inventors have gone far towards rendering it generally available; another step in advance will dispense with all metallic connexion whatever.—*Spectator.*

Extraordinary Excavator.—"Yankee Geologist."—The following is a description of the wonderful machine, called the "Yankee Geologist," which has recently obtained great celebrity in the United States, for performances, which, for their extraordinary nature, and the peculiar manner in which they are described, will give them almost an air of romance; but, nevertheless, having reason to believe the "Yankee Geologist" to be an extraordinary invention, and capable of astonishing deeds, if not of all that is here set forth, I consider a notice of it sufficiently interesting to be deserving a place in your columns:—"We paid a flying visit on Saturday last to Otis' steam-excavator, in Brooklyn, where it is at work digging down the hill formerly known as Fort Green, and filling up the shallow inlet and quagmire, entitled the Wallabout, or so much of it as lies above the old road to Flushing. The 'Yankee Geologist' is surely a great curiosity. He walks right into a mountain as though it were a plate of hot cakes, and dips up a cartload at a shovelfull, as fast as you please. He cuts right and left a path some six rods wide through a hill, and then takes a new swath. He is locomotive, and advances by his own steam-power, whenever the earth has receded before him, grades and stakes down for himself, and only requires one man to shovel and another to look after the fire and engine, though one or two others are generally required to smooth the track before him, &c., besides tending the carts, which approach to be filled on one rail track, and go off loaded by another. If he comes to a stone weighing only a ton, or such a matter, the 'Geologist' 'makes no bones' of it, but pitches it into the cart like a peck of gravel; if he comes to a stone weighing some 4 or 5 tons, he takes him up more carefully, and lays him out on the side of his path. All this is effected by an immense shovel with a sliding bottom, at the end of an immense and complicated arm, worked by much ingenious and novel machinery. The inventor is now dead; the company have spent 30,000 dollars upon the invention before the first machine was made, and much more afterwards. The patent, which is now secured throughout Europe, is probably worth 1,000,000 dollars. An excavator complete costs about 6000 dollars, and will dig and load 1000 cubic yards of earth per day—equal to the labour of 150 men.—*Mining Journal.*

The Manufacture of Watches by Machinery.—A gentleman, who has devoted 20 years of his life to the subject, has made a variety of machines by which an incredible number of watches, of every variety of size, may be made in a day. By one of the machines 300 perfect plates can be produced in a day, by another the same quantity of barrels; by five machines the requisite number of centre, third, and fourth wheels (crossed, polished, and cut) with balances for 300 movements. By another 200 pinons can be cut and rounded; by another the holes are drilled, the tapping, the screw-holes, the various parts in the plate are sunk, planting the depths and escapement, &c., and all with such exactness as cannot be excelled, another for the making and polishing of pivots, &c. Four other machines will be sufficient for making pivots for 50 movements a-day; and to add to these, there are 20 other machines for every description of work connected with the watch-making, and which altogether constitute a set. The inventor has submitted these machines to be scrutinizing inspection of the most experienced makers of chronometers nd watches in London, and not one has expressed a doubt of the work so roduced being incomparably superior to that done in the usual way. Among other distinguished names in the trade we have observed those of Mr. Barwise, Mr. Earnshaw, Mr. Hewett, Mr. Vieyres, Messrs. Frodsham and Co., with about a hundred watchmakers in the country, who, with the Duke of Hamilton and Mr. Howell (of the firm of Howell and James) at their head, are engaged in carrying out the great and national object of restoring this lost and important manufacture to England by means that while they greatly lessen the price, will improve the quality, and entirely undersell our foreign rivals, and be very largely profitable to all parties concerned.

An Astronomical Phenomena.—Mr. Glaisher, of the Cambridge Observatory, reports the following remarkable appearance on the 4th October:—"At midnight the sky had become perfectly clear and the air frosty. At 21 minutes after twelve I was much startled by what seemed to be a vivid flash of lightning, but on turning to discover its direction I saw a bright streak of light in Orion, about 20° in length at the moment of discovery; its centre was as bright as Jupiter, and the light plainly emanated from it in quick flickering waves on each side simultaneously, and at each wave the length and brightness decreased. This part of the phenomenon lasted 10 seconds; I therefore had time to recover my surprise and perceive the working of it. When the waving ceased there appeared to be a bright star in the place where I had seen the centre line of the streak, but whilst considering what star it could be, that I might note with accuracy the place of the phenomenon, I perceived that it gradually faded, and in the course of about two minutes it entirely disappeared, having, unlike the generality of meteors, maintained the same position all this time. The line of direction of the streak made, with Orion's belt to the south-east, an angle of about 40°, the centre light being 3° north of the upper star of the belt, and in the same straight line with the three stars in it. I hope this very singular meteor may have been observed by others, that this account of it may be verified."—*Norwich Mercury.*

Astronomical Clock at Strasburg.—An astronomical clock of remarkable ingenuity has lately been constructed at Strasburg by a M. Schwilgué. It is composed of three parts, respectively indicating the time of the day, the day of the month and year, and the movements of the constellations. The central moving power, which is another and very exact timepiece, shows on the face the hour and its subdivisions, strikes the hours and the quarters, and puts in motion several curious allegorical figures. The cock-crow, which had been mute since 1789, has been reproduced, and a procession of the apostles takes place daily at noon. The calendar shows the months, the days, and the dominical letter, as well as the Catholic calendar, showing every Saint's day in the year. The plate or face on which these figures and signs appear makes one revolution in 365 days for the common, and 366 for the bissextile year, always reproducing the irregularity which takes place three times in every four secular years. The moving fasts and feasts are shown by an extremely ingenious process. On the 31st of December, at midnight, Easter day and the other moving feasts for the year appear on the calendar. The third division is the triumph of the artist's skill. A complete orrery after the Copernican system is produced. The movements of all the planets visible to the naked eye are represented. The earth is shown accompanied by her satellite, the moon, which accomplishes her revolution in one month. The different phases of the moon are represented on a different and separate globe. Another globe represents the apparent movement of the heavens, making one revolution in the sideral day. This movement is subjected to that almost imperceptible power, known by the name of the procession of the equinoxes. The mechanism, besides many other things, shows the apparent movements of the sun and moon with wonderful precision, and for an indefinite period, so that the rising and setting of the sun, its passage to the meridian, the eclipses of the sun and moon, &c., are all represented on the face of the apparent time in a most ingenious manner.

Dredge's Suspension Bridge.—A new iron suspension bridge on Mr. Dredge's principle has just been completed, at Wraybury, in Buckinghamshire, abou 20 miles west of London. It is stated to be a very light and powerful structure, and is not half so expensive as is the timber centreing for a commo stone bridge of the same magnitude. It is 17 ft. wide, 100 ft. span, and in intended for every description of traffic. It is perfectly level from end tos end. It was completed in three weeks after the foundation stone was laid.

The New River Head.—A number of labourers have been emplo ed for some days past in cleansing the immense reservoir belonging to the New River Company, in Claremont Square, Pentonville. The sediment has been allowed to accumulate for 11 years, until at length the present measure became necessary. In some places there are 11 ft. of mud.—*Times.*

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 29TH SEPTEMBER TO 27TH OCTOBER, 1842.

Six Months allowed for Enrolment, unless otherwise expressed.

Edward Bell, of the College of Civil Engineers, Putney, professor of practical mechanics, for "*improvements in applying heat in the manufacture of artificial fuel, which improvements are applicable to the preparation of asphalte, and for other purposes.*"—Sealed September 29.

Samuel Henson, of New City Chambers, Bishopsgate-street, engineer, for "*improvements in locomotive apparatus, and in machinery for conveying letters, goods, and passengers, from place to place through the air, part of which improvements are applicable to locomotive and other machinery to be used on water or on land.*"—Sep. 29.

William Smith, of Grosvenor-street, Camberwell, gentleman, for "*improvements in treating certain animal matters, to obtain products applicable to the manufacture of candles, and other purposes.*"—Sep. 29.

John Rand, of Howland-street, Fitzroy-square, artist, for "*improvements in making and closing metallic collapsible vessels.*"—Sep. 29.

James Hyde, of Duckenfield, Cheshire, machine-maker, and John Hyde, of the same place, cotton-spinner, and manufacturer, for "*an improvement or improvements in the machinery used for preparing cotton, wool, silk, flax, and similar fibrous materials for spinning.*"—Sep. 29.

John Ridsdale, of Leeds, for "*improvements in preparing fibrous materials for weaving, and in sizing warps.*"—Sep. 29.

John Fry Wilkey, of Mount Vernon, Exeter, commission agent, for "*improvements in carriages.*"—Sep. 29.

John George Shipley, of Bruton-street, Berkeley-square, saddler, for "*certain improvements in saddles.*"—Oct. 6.

John Oliver York, of Upper Coleshill-street, Eaton-square, for "*improvements in the manufacture of axles for railway wheels.*"—Oct. 8.

Wilton George Turner, of Gateshead, Durham, doctor in philosophy, for "*improvements in the manufacture of alum.*"—Oct. 8.

Claude Edward Deutsche, of Fricour's Hotel, St. Martin's-lane, gentleman, for "*improvements in combining materials to be used for cementing purposes, and for preventing the passage of fluids, and also for forming or constructing articles from such compositions of materials.*"—Oct. 8.

Samuel Dotchin, of Myrtle-street, Hoxton, jeweller, for "*improvements in paving, or covering, and constructing roads, ways, and other surfaces.*" (A communication.)—Oct. 13.

William Edward Newton, of Chancery-lane, patent agent, for "*certain improvements in the manufacture of artificial fuel.*" (A communication.)—Oct. 13.

Charles Thomas Holcombe, of Valentines, near Ilford, Essex, Esq., for "*an improved mode of using certain materials as fuel; also an apparatus or method for collecting the smoke or soot arising from the combustion of such fuel; which apparatus or method is applicable to collecting the smoke or soot arising from the ordinary combustion of fuel, and also the application of the products arising from the combustion of the first mentioned materials, as a manure, and for other useful purposes.*"—Oct. 13.

Robert William Sievier, of Henrietta-street, Cavendish-square, gentleman, for "*certain improvements in looms for weaving, and in the mode or method of producing plain or figured goods or fabrics.*"—Oct. 13.

Peter Kagenbusch, of Lyth, in the county of York, dyer, for "*certain improvements in the treatment of the alum rock, or schist, and in the manufacture and application of the products derived therefrom.*"—Oct. 13.

Henry Brown, of Selkirk, manufacturer, and Thomas Walker, of the same place, manufacturer, for "*improvements on woollen carding engines.*—Oct. 13.

Thomas Seville, of Royton, Lancaster, cotton spinner, for "*certain improvements in machinery used in the preparing and spinning of cotton, flax, and other fibrous substances.*"—Oct. 20.

James Palmer Budd, of Ystalyfera Iron Works, Swansea, merchant, for "*improvements in the manufacture of iron.*"—Oct. 20.

William Longmaid, of Plymouth, accountant, for "*improvements in treating ores and other minerals, and in obtaining various products therefrom, certain parts of which improvements are applicable to the manufacture of alkali.*"—Oct. 20.

James Statham, of West-street, St. Giles's, Venetian lock maker, for "*improvements in the construction of locks, for Venetian blinds used in carriages.*"—Oct. 29.

Gilbert Claude Alzard, of Tichborne-street, gentleman, for "*certain improvements in bread, biscuits, macaroni, vermicelli, and pastry, and the mode of making the same.*"—Oct. 20.

George Hazeldine, of Lant-street, Southwark, coach manufacturer, for "*certain improvements in omnibuses.*"—Oct. 27.

James Gardner, of Banbury, ironmonger, for "*improvements in cutting hay, straw, and other vegetable matters for the food of animals.*"—Oct. 27.

John Mullins, of Battersea, surgeon, for "*improvements in making oxides of metals in separating silver and other metals from their compounds, with other metals, and in making white lead, sugar of lead, and other salts of lead, and salts of other metals.*"—Oct. 27.

Rowland Williams, of Manchester, fustian shearer, for "*certain improvements in machinery, or apparatus for raising, shearing, and finishing velvets, or other piled goods by power.*"—Oct. 27.

TO CORRESPONDENTS.

L. K.—*We cannot inform him.*

B.—*Sometimes; if he will call at our office, he can consult the Editor.*

W. Williams.—*Address 'The Secretary of the Society of Arts," &c. Adelphi, London.*

T. B., *Self-acting river valve—A paper by Mr. Haydon on the Schools of Design—Notice of Mr. Shuttleworth's Hydraulic Railway*—F. W. S. "*Improvement in the process of Sugar-making—will appear next month.*

O. T.—*We have received his last communication on Railway Curves.*

Mr. James Whites' "elastic friction driver" in the Mech. Mag. No. 1002, Oct. 22, is a decided infringement on Mr. Trewhitt's patent, described in the Journal for last February and April.

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant, addressed to the Editor, No. 10, Fludyer Street, Whitehall.

No. 2 has been reprinted and may now be had of the Publishers.

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SCOTSWOOD SUSPENSION BRIDGE OVER THE TYNE.

JOHN GREEN, ENGINEER.

Fig. 1

ELEVATION OF SUSPENSION TOWER

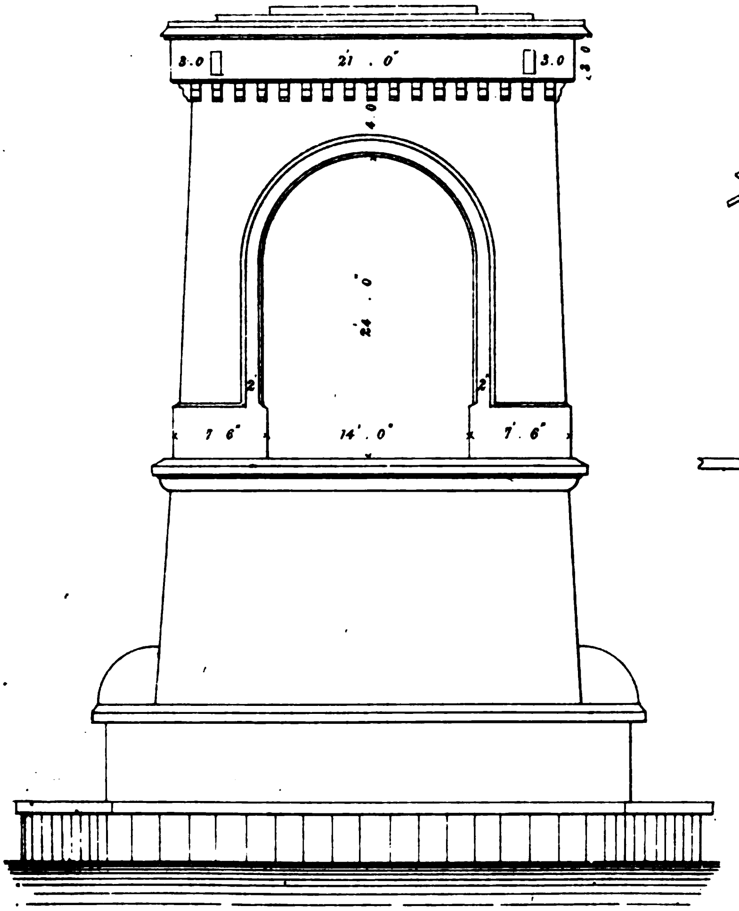


Fig. 2.

SIDE VIEW.

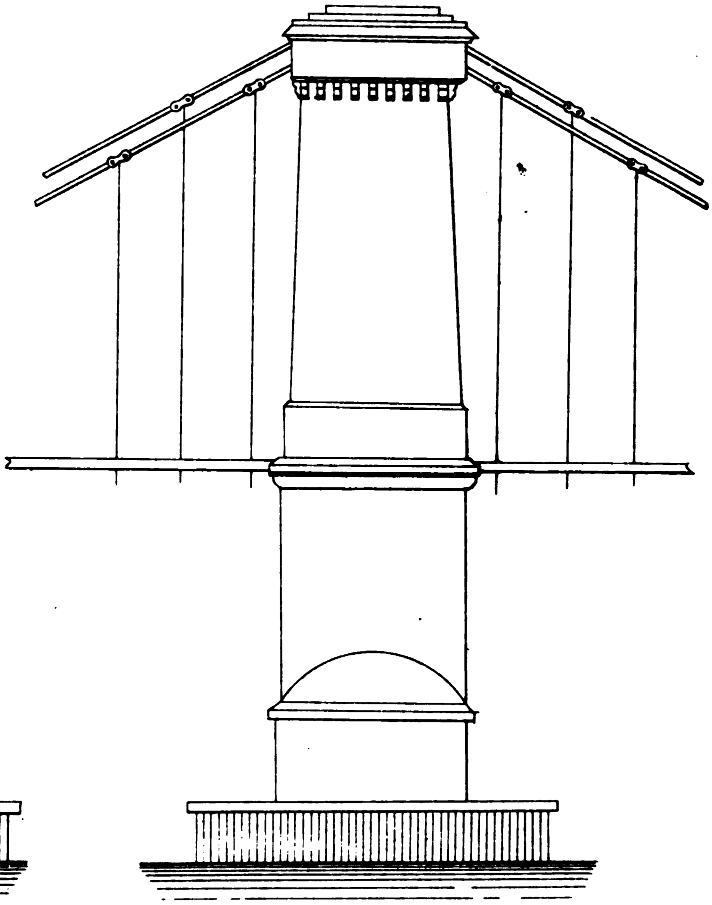
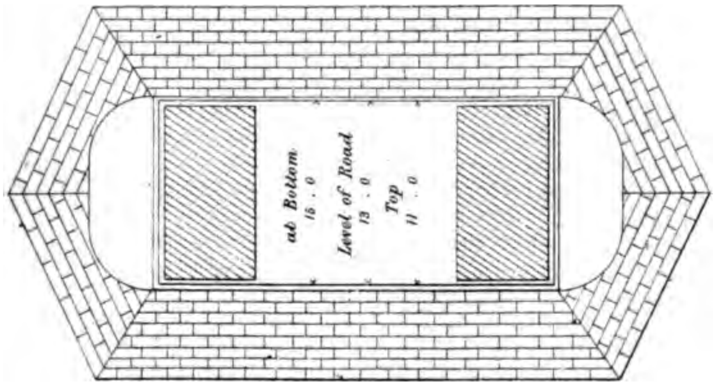
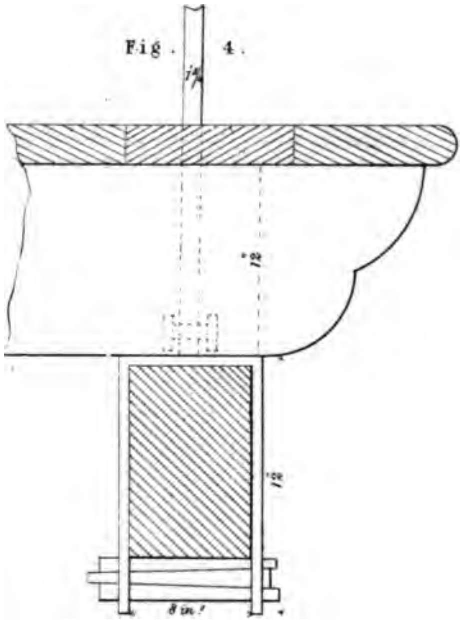


Fig. 3.

PLAN





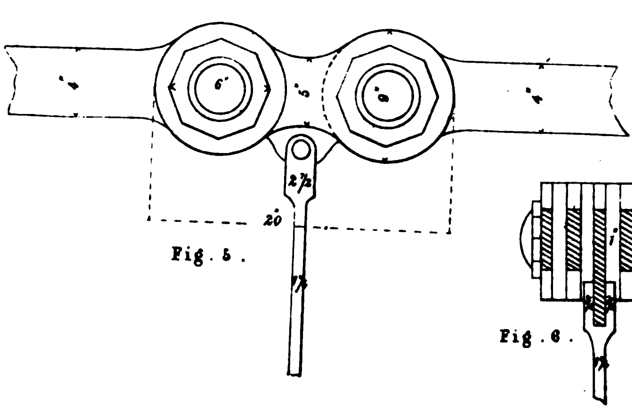


Fig. 5.

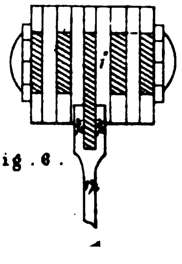
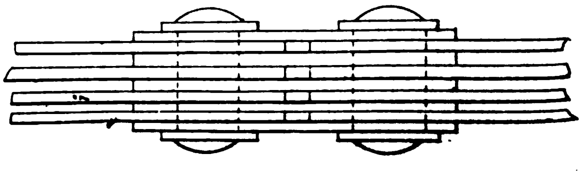


Fig. 6.

Fig. 7.



SCOTSWOOD SUSPENSION BRIDGE,

Erected over the Tyne, near Newcastle.—Engineer, John Green.

(With an Engraving, Plate XVI.)

We are indebted for the accompanying drawing and description of the above bridge, to our valuable correspondent O. T. of Newcastle-upon-Tyne, who has favoured us with several practical papers of great utility, part of which have appeared in the *Journal.*

Scotswood Bridge is erected over the Tyne, in a very picturesque situation, 3 miles west of Newcastle; it was commenced in August 1829, and opened on 12th April 1831. The two suspension towers in design approach the Norman style of architecture, and have a very noble appearance when viewed from the water; they are, together with the land abutments, constructed of solid masonry. The distance between the points of suspension of the centre opening is 370 ft., the two half arcs 130 ft. span each, which with the two towers make a total length of 670 ft. There are four suspension chains, two on each side, one over the other; each chain is 742 ft. long, the chord line of the centre span 370 feet, and versed sine or deflection 26 ft. 6 in.; the links of the chains consist of four flat wrought iron bars 10 ft. long, 4 in. deep, and 1 in. thick, placed parallel to each other, terminated with an eye at each end, and coupled together with five wrought iron plates 5 in. deep in the centre, and 9 in. across the widest part, and 1 in. thick, connected by bolts 2¼ in. diameter, with octagon nuts 4½ in. diameter and 2 in. thick; the bolt holes of the long links are 9 ft. 1½ in. from centre to centre (see Figs. 5, 6, and 7.) The links above the suspension towers have bars 7 in. deep and 1 in. thick and 20 in. long from centre to centre, and connecting plates 10$\frac{11}{16}$ in. long from centre to centre; the roadway is suspended by bars 1¼ in. square to the centre coupling bar, which has a lug on the underside with an eye, through which and the forked end of the suspending bar passes a screw bolt; the lower end of the suspending bar is attached to a stirrup iron grasping each side of the longitudinal string piece, which is carried by the iron wedges, as shown in fig. 4. The suspension bars are alternately suspended to the upper and lower chains. Each bar was proved to 40 tons. The suspension towers are 78 ft. high from the bottom of the footings to the top, and at the base 42 ft. long by 20 ft. 6 in., and above 37 ft. by 16 ft. 6 in., the footings are surrounded with sheet piling. The roadway is 23 ft. broad, which is constructed of Memel timber placed 8 in. apart, the ends resting upon and bolted to the longitudinal string piece on each side, as shown in fig. 4, and the top overlaid with planks covered with a composition of tar and gravel.

The masonry was executed by Messrs. Welch and Son of Gateshead, and the ironwork by Messrs. Walker and Yates of Birmingham. The estimated expense was £12,900, but from unforeseen difficulties in the foundation requiring extra work both in masonry and coffer-dam, the total expenditure was £15,000. At the completion of the bridge the committee for the construction, in order to testify their high approbation of the masterly manner in which Mr. Green discharged his duties as engineer, presented him with a handsome silver claret jug.

Reference to Plate.

Fig. 1, Elevation of suspension tower. Fig. 2, Side view, and Fig. 3, Plan of footings, and the piers of the arch. Fig. 4, Enlarged view of the timbers of the roadway. Fig. 5, Side view of the main chain, coupling links and suspension bars. Fig. 6, Cross section of ditto, and Fig. 7, Plan of top of ditto.

Greenhithe Pier.—On Monday, Oct. 31, the retired and beautiful village of Greenhithe assumed a most animated scene, upon the occasion of the opening of this Pier. On the arrival of the first steam-boat at the Pier, which conveyed several of the Directors and Shareholders of the Pier Company, they were received by a numerous assemblage of their friends.

The Pier is constructed of timber, and is remarkable for durability, chasteness, and elegance, and reflects great credit on Messrs. Birch, the engineers and designers,

CANDIDUS'S NOTE-BOOK.

FASCICULUS XLIII.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. "Barry's Book" seems likely to become a by-word, and many are now endeavouring to pick a leaf out of it, some with very fair success, others with none. Rarely can imitators discern the difference, wide as it is, between *manner* and *manner-ism*: they just catch hold of some of the more prominent characteristics of the former, and then apply them at hap-hazard and on all occasions. There is almost always something to betray that they do not enter into the spirit of what they evidently propose to themselves as a model. So long as they have some express model to go by, and adhere to that, they may get on well enough, but no sooner do they begin to deviate from it, than they render manifest how very different their own unguided taste is from that which they have assumed, but which sits upon them most awkwardly and ungainly. It may be said that Barry himself is but an imitator, and that most of his ideas may be traced to direct authorities for them. Still, if this may seem to detract from him in some degree as an inventor, it also shows how very differently from his predecessors he looked at Italian architecture. How happens it that that particular mode which he introduced, and has brought into vogue, should, till then, hardly have been known in this country? The same sources from which he derived his taste had been open to others for at least two centuries, without their benefitting by them, or being able to perceive their value. Neither has he followed his models implicitly, even where he is most open to the charge of direct imitation: on the contrary, he has discriminated between their beauties and their defects, of which latter some are glaring enough, even in works that are stamped by no ordinary merits. Those singular inequalities of taste which mar or disfigure some of the finest, and what may be called the purest, examples of the Italian style, he has happily avoided, giving us, as it were, the very cream of that style. It has been remarked before now—probably by myself also—that one very great, and, I am sorry to say, uncommon merit in Barry's designs is, that they are all of a piece, and all carefully finished up. In others there may be very happy ideas, and great merits in parts; but then it is generally only in parts, and in many instances the faults preponderate over the beauties; at least neutralize them, jarring most harshly, like so many false notes in music.

II. Mr. Barry's example and that of others, who, in re-adopting Italian architecture, have gone to what may be distinguished by the name of the Ante-Palladian style, may be taken as a tacit confession on their part, that the Palladian itself is greatly inferior to the other; and however disposed they may be to join with those who cry up the Palladian school—for the sake, perhaps, of quietness—their practice unequivocally condemns it. Independently of its intrinsic merit, one thing which at present recommends the species of Italian introduced among us is its novelty; but as that attraction can be of no very long duration, it could be wished that an attempt were made to throw more variety into it, instead of invariably aiming at the same or nearly the same character, not only as regards the general mass, but also the individual features and members. The same style would admit of great diversity of treatment in regard to windows, a source of variety all the more worth being turned to as much account as possible, because little scope for variety is afforded in regard to the general composition. Fortunately, Barry himself has furnished me with an illustration of what I could wish to see pursued and carried much further, —in the south façade of the Travellers' Club-house, where the windows are of more ornate character and more original design than usual, and the whole is more playful, yet the style is not at all violated; its breadth and repose are preserved, and there is simplicity combined with richness, and what is more, that richness is combined with gracefulness. That front is also a happy instance of what may be done by merely having recourse to rustication as a means of embellishment.

III. In continuation of the remarks on the style above spoken of, one thing that is not to be lost sight of is, that justice cannot be done to it, nor its character kept up even tolerably well, if the proportions be neglected—proportions all the more deserving of notice, because little mention is made of them, and little attention paid to them; namely, the proportion of solid wall to the apertures, both as regards breadth of piers between windows, and breadth of horizontal surface between the separate floors and their windows. If sufficient space cannot be allowed for these proportions, very much that is essential to character is forfeited, although the composition and all its details may be just the same as where the due proportions are observed. All grandeur of manner is lost, and is replaced by a certain littleness and offensive "squeeziness,"—a term, by the bye, that may very well be allowed to pass current, as it is sufficiently expressive; nor is exception to be taken to it, when the fault itself which it describes is tolerated much more than it ought to be. It is this "squeeziness," among other things, that causes those long slips yeleped Terraces, in the Regent's Park, to look like so many barracks flashily bedizened out with all sorts of Brummagem architectural finery—sham pediments, columns, (crammed in between windows) pilasters, fluted in order to make amends for hole-in-the-wall doors, and here and there a *painted* sham window—to say nothing of garrets peeping over balustrades, and chevaux-de-frize of chimneys, bristling like so many porcupines on the roofs. Compare Chester or Cumberland Terrace with the Reform Club-house; the first are all bloated littleness, made up of would-be finery, and without the least refinement. On looking at them, you long to block up every other window, to take away their columns and starved entablatures, and to give them a cornice where a cornice ought to be, above and not below the uppermost windows.

IV. If a memorial of nothing else, the column in—or rather poked out of—Trafalgar Square, will serve to keep in recollection the extraordinary fact, that after two competitions, and from among nearly 200 designs, some of them by our chief architects and sculptors, no greater effort of genius could be selected, nothing better worthy of being carried into execution, than the hackneyed common-place idea of a huge column, which any one who can draw can *design*. It will now stand as a monument either of the utter incompetence of British artists to accomplish anything superior, or of the utter incompetence of the Committee to form any opinion; and of their sulky obstinacy in persisting to adhere to their unfortunate choice, after the extreme dissatisfaction expressed at it, and after they had actually held out the hope of abandoning it, by allowing a second competition to take place, thereby affording themselves an opportunity for correcting their former mistake. Far more creditable, because far less impudent, would it have been on the part of the committee, to have at once refused all further competition, contenting themselves with disappointing our expectations once. If they were determined to stick up a long pole, there was at least no occasion to make of it two *baulks*. One baulk was quite enough, in all reason; the second might, in decency, have been spared us. The only excuse is that they seem to have taken Nelson's own motto for their guidance, but construed it most unluckily, supposing "*Palmam* qui meruit, &c." to mean "Anything may be *palmed* upon poor John Bull." They may have honoured Nelson, though very equivocally, but they have most unequivocally disgraced themselves by erecting what will be an object of contempt and derision to all persons of taste.

V. Common as it is, it is a very lame and shuffling excuse when those who profess to give us historical and critical remarks on architecture, break off as soon as they approach their own period, under the pretence of being restrained by "delicacy" from speaking of their contemporaries. In most cases the real truth would be, that they have no opinions of their own to offer, and can get no ready-made ones out of books, as they can respecting persons and things that have been spoken of repeatedly. A nice man, Swift has told us, is a man of nasty ideas; and so, in the delicacy of these over-scrupulous writers, there is something the reverse of complimentary. The inference to be drawn from their silence is, that were they to offer any opinions at all, they would be highly prejudicial and offensive ones. They are too good natured to censure, and are by far too scrupulous to commend, against their critical conscience. Delicate souls! but then why do they meddle with what requires a firmness of purpose which they do not possess? why do they undertake an office so highly disagreeable to their feelings, and so much at variance with their notions of propriety and discretion?

VI. I have often observed that those who affect to attach little or no importance to "matters of mere taste," are apt to be excessively sore if you venture to find fault with their own taste. After telling you that what they have done makes no pretensions to merit of design in any respect, after assuring you that there is nothing to admire in it, such persons will look confoundedly nettled at you if you point out faults that might easily have been avoided. While with mock humility they disclaim your admiration, they not only expect you to express it, but are sulky if you do not. While they profess to have built merely to please themselves, they are angry if every one else does not profess to be equally well pleased also. I well remember one captious individual of the kind, who was so excessively indignant at some comments on the taste shown in the front of his house, which had a large bird-cage-looking viranda on Ionic columns, that he blustered most terribly, and talked of bringing his action against the publisher of the periodical wherein they had appeared! Most unquestionably every one who builds has a right to please himself—to erect a row of brickbat battlements on the top of a cockney-looking sash-windowed house, and call it a castle; or to commit any other absurdity. Yet while he in that manner avails himself of the *Meum* side of the privilege, let him not forget the *Tuum* one, but bear in mind that people are just as much privileged to laugh at him, as he is to make a fool of himself, and have just as much right to ridicule his bad taste as he has to display it.

VII. Not much dependence is to be put upon Nagler's "Künstler-Lexicon;" at least not for its notices of English artists. The article on the late Augustus Pugin, is little more than a tissue of blunders from beginning to end. Although he died at the end of 1832, he is spoken of as still living; and although he was about 63 at that time, he is said to have been born in 1780, and to have been a native of London! For a long time, we are told, he devoted his attention to the public buildings of the English metropolis, before he began to direct it to the study of Gothic architecture, travelling through his native country for that purpose! In the year 1839, it seems, he began the Roman Catholic church at Manchester, one of the finest specimens of Gothic in this country! It is a pity that Nagler did not mention the "Contrasts" as one of his publications; more especially as he has not scrupled to attribute to him the illustrations in Britton's Cassiobury—or as he spells it, *Castuobury*. Nagler, it is to be hoped, does not blunder quite so much by wholesale, in his notices of Continental artists, because he is perpetually quoted as the authority for articles of that kind, in the new "Biographical Dictionary."

VIII. Whatever the reviewers may say of Mr. Gwilt's new work, they will hardly accuse him of servile adulation to the powers that be! When speaking of palaces—instead of sliding in a graceful compliment to Windsor Castle as being the bright particular gem which redeems this country from the reproach of having no worthy abode for its sovereign, he damns it with faint praise, uttered in a very sneering tone. Windsor Castle, he gives us to understand, is very far from being a model for a palace, and that its attractions lie more in its site and scenery than in its architecture. He has taken care, however, that posterity shall not learn from him the name of the architect employed upon it, for no where does he mention Sir Jeffry Wyatville, whom he has excluded from his list of architects—as he has, likewise, James Wyatt, although he has given a place in it to some individuals of far less note. Of course the omission must have been intentional, since it is not for a moment to be supposed that either Mr. Gwilt or any one else at all acquainted with the history of modern English architecture, should not know of, or forget, such persons. Surely James Wyatt might have been admitted into the company of Isaac Ware and James Payne, neither of whom were very brilliant luminaries in the art; although the first of them edited Pal-

ladio—a very great merit indeed in Mr. Gwilt's eyes. Whatever his real abilities, Wyatt was incontestibly a celebrated architect, and entitled to notice, if only as forming an epoch in the art, by being the first to revive in practice, with any tolerable success, the pointed style. If such omissions are to be understood as tacit condemnations of the parties so excluded, they are not on that account the more warrantable. Mr. Gwilt holds his St. Peter's keys rather too tightly; since he passes over the name of Borromini in his list of architects, he would probably exclude that of Cromwell from a history of England, or Nero from that of Rome. Were biographical works to be drawn up on the same principle of exclusiveness, were the names of only the pre-eminently great and worthy to be admitted into them, the 70 volumes of the Biographie Universelle, would shrink down to seven. After seeing Mr. Gwilt's *Paradiso*, we should like to take a peep at his *Inferno;* and as we do not meet with Cagnola, Schinkel, Wilkins and Wyatville in the former place, we shall, no doubt, find them stowed away in the latter.

THE ECCLESIASTICAL COMMISSION AND THE ARCHITECTURAL SOCIETIES.

Our present number affords much matter for meditation, and particularly to those who think these are times to set the public and the march of intellect at defiance. To the unprejudiced observer it will be pretty evident, that if the architects neglect their public duty, there are others who will do it for them. The profession must, therefore, be up and stirring, or the Architectural Societies will play the *Maires du Palais* to their *fainéantisme.* While the Royal Institute of British Architects can scarcely find matter for its papers or for its transactions, or any thing to do, *lay* architectural societies are springing up over the country, which find plenty to do, and seriously threaten the prerogatives of architects. With the progress of these societies we are much pleased; they are a good sign of the times, they promise to educate the public, to employ the architect, and to preserve our ancient monuments. But here we must stop—we cannot allow the societies to be supreme judges of architectural merit and the dispensers of patronage; we think that they cannot become so without injury to the art and its professors: it must take away the responsibility from the architect and tend to patronize show instead of solidity. As an instance showing some of the fruits of the proposed system, we call attention to an advertisement from the Yorkshire Architectural Society in our present number, calling on architects to send in designs, without stating whether they are to receive either premium or employment. We also invite attention to the outrageous proceedings of the Ecclesiastical Commission, by which all the parsonage houses of the country are to be put under one architect; and the same steryotyped designs universally distributed. Now is the time, therefore, for the Institute to exert itself, to show regard in its proceedings, to defend manfully the rights of the profession, and to keep pace with the spirited exertions of the architectural societies.

DIRECT ACTION ENGINES.

As it has been our good fortune to have published drawings and descriptive letter-press of various engines of this class—the productions of some well known firms, it is now our intention to give an analysis of the same, as it relates to their general proportions and arrangements, strictly adhering to information derived from the published statements, making few comments, detailing facts, believing the same will be interesting to our readers. We began with Mr. Field's 2 cylinder engine in March 1840, Mr. Joseph Maudslay's annular engine followed in October 1841, which was succeeded by the *Virago* engine of Boulton and Watt, in its turn followed by the *Infernal's* engine of Miller and Co., ending with a design for a pair of engines by Borrie and Co. of Dundee. We now propose to analyze these in the order of their publication.

Mr. Field's double cylinder engine, published March 1840, *p.* 73, *vol.* 3.

Each cylinder 35 in. diameter and 3 ft. 9 in. stroke, regular speed say 26 strokes per minute, or 195 ft. Then 35 inches diameter $= 962{\cdot}115$ inches area $\times 2 = 1924{\cdot}23$ inches and $\frac{1924{\cdot}23 \times 195 \times 7}{33000} = 79{\cdot}593$ horses for both cylinders, or in round numbers, say 80 H.P., for which they were probably intended.

Piston Rods 3¼ in. diameter $= 10{\cdot}21$ in. area, less than $\frac{1}{10}$ diameter of cylinder.

Connecting Rod 5½ in. diameter $= 23{\cdot}75$ in. area, a little more than both piston rods.

Air Pumps 24 in. diameter and 2 ft. 4 in. stroke. The area $= 452 \times 28$ in. stroke $= 12666$ cubic inches contents, and the cubical contents of both cylinders, (area $1924{\cdot}23 \times 45$ in. long) $= 86590{\cdot}35$ cubic inches $= 6{\cdot}85$ times the contents of air pumps.

Condenser 3 ft. 10 in. across, 1 ft. deep, by 7 ft. 6 in. long = 28 ft. 9 in., say with convexity of cylinder bottom = 30 ft. cube.

We have $\frac{30}{80} = {\cdot}375$ of a foot per horse, or for air pump (contents $= 7{\cdot}318$ cubic feet) $\frac{30}{7{\cdot}318} = 4{\cdot}1$ times.

Shafts. Centre of shafts 12 ft. 6 in. above bottom of condenser, or top of vessels floor timbers, adapted to a ship of 8 ft. 3 in. draft, wheel being 16 ft. 3 in. diameter, × 5·3 long and 21 in. breadth of paddle, necks 9½ in. diameter and 8 in. long, same as annular engine.

Slide openings, or ports, 11½ in. long × 3 in. wide for each cylinder = 69 in. area. Slide valve ròund, 15 in. diameter and 7 in. motion.

Space required. Fore and aft = 10 ft. 9 in.
Over all athwart = 12 ft. 9 in.
or say a superficial space of = 132 feet.

Mr. Joseph Maudslay's annular engine, pub. Nov. 1841, *p.* 369, *vol.* 4.

Cylinder, 54 in. diameter $= 2290$ in. area, and diameter of internal tube $= 25$ in. $= 491$ in. area, and $2290 - 491 = 1799$ in. the area of the working piston. Stroke 4 ft. = 200 ft. per minute at 25 strokes. We have $\frac{1799 \times 200 \times 7\text{lb.}}{33000} = 76{\cdot}3$ H.P.

Piston Rods. Two in each cylinder, each = 3¾ in. diam. $= 11{\cdot}044$ area $\times 2 = 22{\cdot}088$ or 5¼ in. diam. if in one, rather less than $\frac{1}{10}$ diam. of cylinder.

Connecting Rod, = 5 in. diam. $= 19{\cdot}63$ area, or less than both piston rods.

Shafts, necks 9½ in. diam. by 8 in. long, same as in the two-cylinder engine.

Air Pumps, 26 in. diam. $= 531$ in. area $\times 2$ ft. stroke $= 7{\cdot}372$ cubic ft. content. Cylinder 12·5 ft. area × 4 ft. stroke = 50 ft. cube contents, and $\frac{50}{7{\cdot}372} = 6{\cdot}75$ times the air pump.

Condenser, (as near as can be obtained from drawing,) is 5 ft. × 6 ft. 6 in. × 12 in. = 32·5 cu. ft. content. Then $\frac{325}{76.3\text{ H.P.}} = {\cdot}125$ of a foot per horse, or for air pumps $\frac{32{\cdot}5}{7{\cdot}372} = 4{\cdot}4$ times air pump.

Slide openings, 19 in. long by 3½ in. wide = 66·5 in. area, or smaller in proportion than the two cylinder engine.

Space required, is fore and aft, 8 ft. 6 in.
Athwart, with 3 ft. passage between, 16 ft. 3 in.
Say a superficial space of 138 ft.

Virago Engine by Boulton, Watt and Co., pub. Feb. 1842, *p.* 55, *vol.* 5.

Cylinder, 64¾ in. diam. $= 3292{\cdot}8$ in. area, 5 ft. stroke, and 21½ strokes per minute, or 215 ft. = 150 horses each. Thus $\frac{3292{\cdot}8 \times 7 \times 215}{33000} = 150$ H.P.

Piston Rods, 6 in. diam. = 28·27 in. area, say about $\frac{1}{11}$ of cylinder's area.

Connecting Rods, 6½ in. diam. ends, and 7½ middle, say 6½ = 33·18 area, or about an ⅛ more than piston rods.

Length of Rod, is 8 ft. 2 in. Shaft being 19 ft. 9 in. from top of floor timbers of ship.

Air pumps, section not shown on drawing, but appear to be 37 in. diam. = 7·466 ft. area × 2·5 stroke = 18·66 cubic ft. content per stroke.

Cylinders 64½ diam. = 22.70 ft. area × 5 ft. = 113·5 cu. ft. contents, and $\frac{113{\cdot}5}{18{\cdot}66}$ = six times the air pump.

Condensers, each engine separate, 10 ft. 10 long × 6 ft. 3 × 2 ft. 8 deep = 180 cu. ft., but deducting slides, air pumps, foot valves, &c., the content is 100 cu. ft., or 50 for each engine, or ⅓ of a ft. per horse, and for air pump, $\frac{50{\cdot}0}{18{\cdot}66}$ = 3·7 times its contents.

Shafts are 11½ in. diam. at necks, and bearing 13 in. long, the centre, bearing a crank to work air pump, is 15 in. diam. by 6 in. long,

Slide Valves. Thoroughfares or ports, 5 in. × 24 in. = 120 in. area.

Hot Water Cistern, is 2 ft. 10 in. wide, 3 ft. 11 in. long, and 4 ft. 1 in. high, contents 45·3 cu. ft. less exhausting passages = 35·7 ft. true contents. Air pump contents 18·66 ft. we have $\frac{35.7}{18{\cdot}66}$ = 1·92 times, say twice the contents of air pump.

Waste Water Pipes, 9 in. diam., the hot water cisterns acting as an air vessel.

Columns, wrought iron 7 in. diam. at bottom and 5 in. at top. Lower columns, cast iron, 10 in. diameter. Space occupied is 18·6 athwart, and 6·4 fore and aft, the width of cylinders. Air pumps being in centre line of ship, thus,

18·6 by 6·4 =	117·2 sq. ft.	
Air pumps 4 ft. 8 in. × 6·6 =	30·4 „	
		147·6 sq. ft.

Mr. Joseph Miller's Direct Action Engine, published June 1842, *p.* 177, *vol.* 5.

Cylinder, 65 in. diam. (3318·31 in. area) 5 ft. stroke, 21½ strokes or 215 ft. per minute, power 151·33 horses.

$$\text{thus } \frac{3318{\cdot}31 \times 7 \times 215}{33000} = 151{\cdot}33 \times 2 = 302{\cdot}66 \text{ H.P.}$$

Piston Rods, 6 in. diam. = 28·27 area, less than $\frac{1}{11}$ of cylinder.

Connecting Rods, 6½ in. diam. at end, and 7½ in. at middle, say 6½, = 33·18 in. area, or about ⅛ more than piston rod. Length of rods, 8 ft. 6 in. Shaft, 19 ft. 6 in. from floor timbers.

Air Pumps, 30 in. diam., (706·86 in. area, or 4·90 ft.) and 2 ft. 6 in. stroke; 4·90 ft. × 2·5 = 12·25 cu. ft. contents. Cylinder = 23·04 sq. ft. × 5·0 = 115·20 c. ft. contents, and $\frac{115{\cdot}20}{12{\cdot}25}$ = 9·4 times the air pump.

Condenser, each engine separate, 3 ft. 2 in. wide × 2 ft. 6 in. fore and aft, and 4 ft. 6 in. high contents = 35 cu. ft. for each engine, and $\frac{35}{151}$ = ·233 of a foot per horse, and $\frac{35}{12{\cdot}25}$ = 2·85 times the contents of air pump.

Shafts (as far as drawing shows) are 12 in. diam. by 14 in. bearing.

Slide openings, 24 in. long, depth not shown, hollow slide, exhausting between the two faces, steam given at top and bottom.

Hot Water Cistern, 2 ft. 3 in. wide, 1 ft. 4 in. fore and aft by 1 ft. 8 in. deep. Contents = 5 cu. ft., or half air pump's content.

Waste Water Pipes, 12 inches diam. = 113 in. area, say $\frac{706}{113} = \frac{1}{6{\cdot}5}$ part of air pump's area.

Hot Water Pumps, 6 in. or 6½ in. diam. and about 21 in. stroke.

Columns of wrought iron, 5 in. diam. bolted to the top flange of cylinder, and not proceeding to their bases.

Space occupied is marked 8 ft. by 18 ft. 6 in., but over the feeding pumps and slides it measures 9 ft. 3 in., and athwart over the steam pipes and expansion valves it is 19 ft. 6 in., according to the dimensions marked 8 ft. × 18 ft. 6 in. = 148 ft. superficial.

Mr. Peter Borries Engines, Dundee, designed Nov. 1841, *published July* 1842, *p.* 213, *vol.* 5.

Cylinder 71 in. diam. (3959·2 in. area) and 5·6 stroke, 221½ ft. or 19¾ strokes per minute = 186 horses each, or 372 H.P. for both engines, thus $\frac{3959{\cdot}2 \times 7 \times 221{\cdot}5}{33{,}000}$ = 186 H.P. × 2 = 372 H.P.

Mr. Borrie calls the collective power of the two engines 352 H.P., at 210 ft. per minute, and 7lb. pressure; and further says, supposing pressure 8·5lb. and 210 ft. = 426 H.P. We suspect these data to be taken from the government contracts, probably coined at the Woolwich mint; as we prefer the authority of the late James Watt, we have followed his system, his proportions and pressure.

Piston Rods. 7 in. diam. or about $\frac{1}{10}$ the cylinder's diameter.

Connecting Rods, 7 in. diam. at end, and 9 in. in the middle, say 7 in. area = 38·48 or same as the piston rod.

Length of the Rod, is 8 ft. 4 in. only, shaft being 21 ft. 3 in. from floor.

Air Pump, is peculiar and novel in its application only, being Desagulier's double action pump,[1] solid piston, valves and side pipes. Its diameter is 48 in. and 2 ft. stroke. We have 48 in. = 12·56 area × 2 = 25·12 contents, and $\frac{151{\cdot}195}{25{\cdot}12}$ = ⅙ contents of the cylinder.

Condenser, one for both engines, as well as *one* air pump; it is 7 ft. wide, by 7 ft. long, and 7·5 high = 367·5 total contents. Deducting air pipes and valves, &c., its true contents is 225 cu. ft., and $\frac{225}{372}$ = ·60 of a foot per horse, and $\frac{225}{25{\cdot}12}$ = 9 times the air pump, and $\frac{9}{2}$ = 4·5 times, supposing two air pumps, or one half to each engine.

Shafts, bearings are shown 15½ in. diam., and 22 in. long, or 1 to 1·4 of the diam., or about 3 in. larger in diam. than the proportions of the engines before detailed.

Slide Valves, are circular, 19 in. diam., ports 30 in. long, by 7 in. deep, = 225 in area.

Expansion Slides, are very simple and effective, its motion very small, and worked without noise.

Hot Water Cistern, is 12 in. fore and aft, 6 ft. high, and 4 ft. 6 in. wide, = 27·0 cu. ft., or for each engine = 13·5 cu. ft. or about half the air pump.

Waste Water Pipes, and hot water pipes, not clearly shown.

Columns, lower, of cast iron like *Virago* engine, and same diam. = 10 in., top part is a cast iron framing of tolerable design, heavy, though firm. We observe a good arrangement—the means of removing and replacing the steel strips in the cylinder guides, which soon wear from the great pressure. All engines of this class (with guides) should be so made.

Space occupied, is 10 ft. 6 in. from back of cylinder to face of expansion slide, and 12 ft. 3 in. over the steam pipes, and 22·6 from out to out transversely, being a rectangle of that size, or say 236·25 ft.

We have now analysed each of the five engines separately without drawing any comparison between them, or offering any comment or observation on their construction, or the adaptation of the direct action engines for vessels of the first rate class, such as are now being constructed by Government. Our only object for the present was simply to ascertain their relative proportions, and which we now propose to give in a tabular form.

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[1] To be seen at the Southwark Water Works and St. Katharine's Docks: particularly the latter, there being six pumps of this description worked by two 60 horse engines, erected by Boulton and Watt in 1828.

TABLE OF PROPORTIONS OF DIRECT ACTION ENGINES.

		2-Cylinder Engine.	Annular Engine.	Virago.	Miller's.	Borrie's.
Horse power		80	76	150	151	186
Cylinder, inches diameter		35 each	54	64¾	65	71
„ length of stroke	ft. in.	3 9	4 0	5 8	5 0	5 6
„ speed per minute	feet	195	200 0	215 0	215 0	221 5
Piston rod, inches diameter		3⅛	2 of 3¾	6	6	7
Proportion of ditto to cylinder		1/10	1/10	1/10	1/11	1/10
Connecting rod, inches diameter		5½	5	6½	6½	7
Length of ditto	ft. in.			8 2	8 6	8 4
Air pump, diameter	inches	24	26	37	30	one 48
„ length of stroke	ft. in.	2 4	2 0	2 6	2 6	2 0
„ contents	cubic ft.	7·348	7·372	18·66	12·25	25·12
„ proportion to cylinder 1 to		6·84	6·75	6·0	9·4	6 0
Condenser	cubic ft.	30 0	32·6	50 0	35·0	225 6 (one)
„ space per H. P.	cubic ft.	·375	·425	·3	·231	·6
„ times larger than air pump		4·1	4·4	3·7	2·85	4·5
Shafts diameter	inches	9½	9½	11½	12	15½
" length	inches	8	8	13	14	22
Slide opening	inches	3 × 11½	3½ × 19	5 × 24	× 24	7½ × 30
Hot water cistern	cubic ft.	none	none	35 7	5 0	13 5
Waste water pipes	inches	square	square	9	12	
Hot water pump diameter	inches			7	6½	
Stroke length of	ft. in.			2 6	1 9	
Space occupied by engines,	area ft. in.	131 8	138 10	147 6	148 0	236 25
" fore and aft	feet	10 9	8 6	6 4	9 3	10 6
" athwart	feet	12 3	16 4	18 6	19 6	12 3

THE LIGHT OF ALL NATIONS.

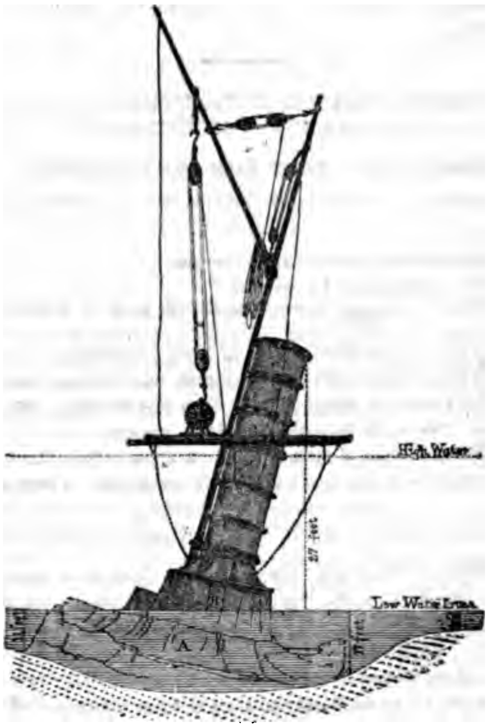
In our *Journal* for October last, we gave a description of the works then being carried on of the lighthouse proposed to be erected on the Goodwin Sands, and promised to give a drawing showing the construction of the caisson; since then the whole of the works have been destroyed, in consequence of a vessel in one of the severe gales in the middle of October last, during the night running foul of it. Notwithstanding this disaster, we think it will be interesting to our readers to know in what manner the works were carried on, and the construction of the caisson; as the record of failures is frequently of as much benefit as the record of successful works, we have therefore obtained the following reports of its progress, for which and for the cuts we are mainly indebted to the *Nautical Magazine.*

"On the 28th July, at half-past 10 o'clock. P.M., the Monkey steam-tug succeeded in getting Mr. Bush's caisson afloat. She went off from the beach in fine style, maintaining a vertical position during her transit, although she made a good deal of water. The pumps were kept going nearly the whole of the way out. About 5 o'clock, P.M., being at the appointed place, the tug cast off the towing rope, and the caisson soon settled down, though a little out of the perpendicular. She at present declines from north to south about 2 ft. in 24, yet it is believed that, in the operation of sinking the foundation, Mr. Bush will be able to rectify this. One of the large boats from the dockyard accompanied the caisson to the sand, having on board plates for commencing the necessary work immediately.

"On the 16th August, Mr. Bush reported that the caisson was sunk below the sands 16 ft. at low watermark, and that the whole portion was then 42 ft. high, being 9 ft. above high water, and that, in the course of the following week he hoped to add 10 ft. more, with every prospect of speedily finding a foundation suitable for the base of such an undertaking.

"The annexed wood-cut represents the appearance of the caisson on the morning of the 21st of August, showing the mode by which the consecutive iron cylinders were placed over each other to form the building for the lighthouse; and showing also the settlement which had gradually taken place, as well as its inclined position, owing to the sand beneath it giving way over the foundation which is supposed to be of chalk. This inclination Mr. Bush appeared to have overcome by the report, dated the 12th September.

Fig. 1.

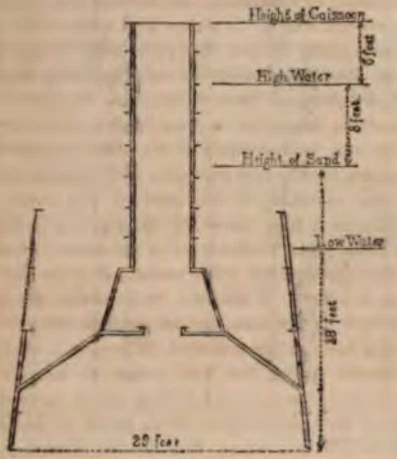


"*Sept.* 2.—Mr. Bush reported that he had in conjunction with Lieutenant Batt, R.N., minutely surveyed the caisson, and found, that after the late stiff breezes it had adjusted itself to a more upright position; that there were 18 ft. of water around it at low water, but at 20 ft. distance there were only 5 ft. A basin had therefore been formed by the strong tides, which proved most satisfactorily that he was but a short distance from the chalk; this was also confirmed by the caisson not having sunk for the three previous weeks more than 5 inches.

"*Sept.* 12.—Mr. Bush again reported that he, accompanied by Lieutenant Batt, R.N., in Her Majesty's cutter Sealark, made a minute survey of the caisson after the gale, (of the 6th instant,) and found that it had not the slightest effect upon it, and that it remained quite perpendicular after having been subjected for many hours to the violence of the storm."

A small stage was washed off, which was not of any importance whatever; and the spar and derrick. The part shown by the dotted line was also broken away.

Fig. 2.—Section of Caisson.



By a reference to our description in the *Journal* for October last, the annexed engraving, Fig. 2, will explain the construction of the iron caisson.

NOTES ON EARTH WORK, EXCAVATION, CUTTING, AND FORMING EMBANKMENT UPON RAILWAYS.

ARTICLE III.—EXTENT, FORM, AND PROPORTIONS.

> "Modern practice has reduced it to a price per cubic yard."
> *Professor Vignoles' Lecture, Dec.* 1841.

In my two previous communications (see pages 84 and 186 of the present volume,) I have endeavoured to show what is the price of earth work, taking ordinary soil as the standard, and then stated the price of excavation to be 4½*d.*, and of forming embankment under one mile in length to be 12*d.* and 3*d.* extra per additional mile; and taking the average length to which earth has been led, I find earthwork to have cost on the following lines, Midland Counties, 13*d.*, Derby and Birmingham, 12½*d.*, Great Western, 12*d.*, and North Union, 10¾*d.* I have also stated, at page 186, the extent to which it is prudent to employ horse power to be 2½ miles, and even when there is a steam horse, as the locomotive was once named, it is not prudent to carry earth more than 4 miles. I now propose to consider whether it be not more economical to run excavation to spoil where it is got, and purchase earth on the spot where it is wanted, and for embankment to get it from a side cutting out of the line of railway. At page 84 of the present volume I have given a table of the cost of back cutting or earth excavation from or in the line of intended railway. I now, for the sake of comparison, give a similar table of the cost of side cutting.

The side cutting was of similar material to the cutting in line of railway formerly described, and was made from an angular severance; the length of the side of the triangle next the line was about 20 chains long, and the embankment formed was about 12 ft. in length, about 12,000 cubic yards were moved without the aid of rails, by barrows only; the total quantity being about 40,000 yards; out of 26,000 yards that were moved, 18,000 were got within 20 yards of the edge of the railway, 6000 within 35 yards, and 2000 beyond 35 yards. The contractor was paid per cubic yard 6*d.* within 20 yards, 7½*d.* within 35 yards, and 8½*d* for all beyond that distance. As a security for the performance of the contract, one penny per cubic yard was retained out of his payments, until half the quantity was performed, and he was paid 1*d.* per cubic yard extra for ballast, which was raised from the bottom with horse runs. By a comparison with the price paid for the former cutting, it will be seen that no great difference exists as to price, neither as to the expedition of the one process over the other.[1] The preceding and following tables were obtained by a close attention and personal superintendence of several months, and at an expense that few contractors would go to. The number of wagons were counted by the sub-contractor at the face of the work, and by a person at the tip on the part of the employer; in one case the sub-contractor had bribed the counter to make a false return of the number, but as he was not content with a small defection, it was found out on the second day. Had it been otherwise, the defalcation would have been difficult of detection, as from natural causes, weather, lost time, difference of the earth's tenacity, the number of yards excavated by each man employed, varying as much as cent per cent.

TABLE OF COST OF EXCAVATION FROM SIDE CUTTING.

1837	No. of days' work.	No. of Wagons of 2½ c. yds.	No. of Wagons of 1½ c. yds.	Cubic yds. per man.
March 11	258	40	1452	8$\frac{8}{10}$
18	248	84	1150	8 nearly.
25	358	243	1302	7$\frac{2}{10}$
April 1	376	338	1324	6 full.
8	312	213	1251	8 nearly.

TABLE OF THE NUMBER OF MEN TO NUMBER OF WAGONS.

No. of Men.	No. of Days.	No. of Wagons of 2½ c. yds. each.	No. of Wagons of 1½ c. yd. each.
50	1	..	185
50	1	..	275
50	1	..	294
54	1	17	216
54	1	25	133
49	1	14	190
60	1	61	201
22	1	9	138
51	1	45	239
52	2	31	406
60	2	119	447
60	1	61	201
60	1	58	246
22	1	9	138
54	1	25	133
54	1	41	203
54	1	31	181
54	1	36	192
36	4	48	754
50	3	5	744
52	2	31	406

By comparing the above table with the former tables, it will be found that side cutting is a small fraction cheaper, but the extra quantity of materials and consequent expense will make the two processes equal or nearly so.

Now that the excavation is to be executed at both ends, it will cost only 9*d.*, and having previously stated four miles as the distance or extent to which it is prudent earth should be transported, the cost of which is estimated at 1*s.* 9*d.* by the scale of leadage I have the difference of 1*s.* to play upon. Let us suppose that the land for side cutting is entirely destroyed, and that it was purchased at the rate of 70*l.* per acre, and that the excavation could be got down 6 feet over the whole surface without having to contend with water, which would be as much as could be done, the locality of embankment being valley, often abounding in water; under the above circumstances, the earth would cost excavating 4*d.* per cubic yard, at the side cutting end, and if the value of the land at the spoil end be calculated at half the purchase price, which is only injured, not destroyed, it will cost 2*d.* per cubic yard more, making, with the cost of excavating, 6*d.*, which will leave 6*d.*; this will pay for carrying the earth 2 miles further than first estimated, hence six miles will be the horizontal extent to which earth work can be removed with prudence, or the point where back cuttings, with a leadage of 4 miles, and side cutting with a leadage of 6 miles, will cost equal or 1*s.* 9*d.* per cubic yard.

Having disposed of the horizontal extent to which earthwork may be removed, I will now consider the transverse extent, and the comparison of the cost at one end of open cutting with tunnel, and at the other end embankment with viaduct; I will first then proceed to show where the cost of a tunnel and cutting coincide, taking the cost of a lineal yard of tunnel at £40, and the cost of earthwork at 1*s*. per cubic yard; when the transverse sectional areas amount to 800 superficial yards, the value of the two will coincide and give us the transverse extent of cuttings.

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[1] The Table in the last March No., p. 85, col. 2, line 26, should be, "the fourth the cubic yards moved per man," instead of "the fourth the price per cubic yard."

Then as to embankments, taking the number of cubic yards in the transverse area at 1*s*. per cubic yard, and the price of brickwork for viaducts at 1*s*. per cubic foot, or 27*s*. per cubic yard, then the two prices will coincide when the cubical contents of brickwork in any given length of viaduct is 27 times the cubical contents of an embankment of the same length.

The most extensive excavation known to me is the Cowran, on the Newcastle and Carlisle Railway, which is 40 chains long, and averages 43 ft. deep, its greatest depth is 112 feet; the material is sand without water, and the slopes are 1½ to 1. The highest mound or embankment is also in the North, on the Hartlepool Railway, which is 80 feet high. The amount of earthwork per mile on the Midland Counties Railway, London and Birmingham, and North Union, were respectively 100,000, 107,000, 125,000, cubic yards.

There are other embankments of considerable extent in the North of England, and on the Bishop Auckland and Weasdale Railway. The Denburn Brook, Etherly Dean, Gaunless, and Wear embankments are of the respective heights of 48, 71, 78, and 50 feet. On the Hartlepool Railway, the Hesleton Dene, Edder Acres, and Pespool embankments, are respectively of the height of 80, 70, and 60 feet. On the Clarence Railway there is the Whitton embankment 75 feet high, and the Stillington embankment 60 feet high. The cutting will be as a matter of course of an analogous extent; there are on the Clarence Railway, the Russel, Whitton and Budds Hill cuttings, of the depth of 30, 42, and 67 feet, the latter through new red sandstone, and their cubic contents are respectively 400,000, 220,000, and 200,000 cubic yards, being nearly equal in extent to any of the works on the far famed Liverpool and Manchester Railway.

The form of embankment will depend on the material of which they are composed, and the angle at which the slopes will stand. The ratio has been stated to be

For cutting under 20 feet deep	..	1½ to 1
Ditto exceeding ..	..	2 to 1
For embankments exceeding 50	..	2½ to 1
Ditto under do. ..	..	2 to 1

Formation levels are regulated by the gauge of the railway, and distance between the tracks of the road, and proper allowance for side drains. On the Great Western, where the gauge is 7 feet, and the distance between the two roads is 6 feet, the width of cutting at the formation level is 29½ feet and 31 feet, and embankments 34½ feet, and between parapets of bridge 30 feet. On other lines where the old gauge of 4 feet 8½ inches is used, and the distance between the two roads 4 ft. 8½ in. also, a uniform breadth of 27 ft. is used. A considerable difference of opinion exists on this subject, viz., the proper gauge of railway; and it is supposed to be a gauge between the two above-named, the Eastern Counties having adopted 5 ft., the Scotch Railway 5½ ft., the Irish Commissioners 6 ft., and the Belfast and Armagh 6 ft. 2 in.

To return to the Great Western, the width at level of rails in cutting is 40 ft., level of ballast 25, 26½, and 28 ft.[1] On the Midland Counties Railway the formation and cutting was 27 ft., as also the top of ballast, and of embankment 40 ft., being 5½ ft. wider than the Great Western, although the old gauge was adopted. This is the only line where earth in mounds 3½ ft. high was made along the embankment to act as a parapet; this was the reason of the extra width: these mounds were abandoned on account of their expense and their subsiding unequally.

The following rule of progress of earthwork on the Midland Counties Railway I extract from the local papers, being returned by Mr. Thomas Woodhouse, who I believe is the only engineer who has given such a complete one to the public.

1839.	No. of Men.	No. of cubic yards per month.	No. of Horses.	Locomotives.	Stationary engines.
23rd March to 20th April	5071	374,085	511	3	1
20th April to 18th May	5138	297,960	513	3	2
4th June to 30th June	4038	13,933	2385	"	"
27th Aug. to 22nd Sept.	4373	203,037	438	1	"
22nd Sept. to 27th Oct.	4597	284,160	498	1	1
27th Oct. to 24th Nov.	4485	210,722	505	1	1
24th Nov. to 29th Dec.	4035	195,174	457	2	1

The following are the mishaps which have been most prominently before the public. On the Great Western, the Sunning cutting in Berkshire, 57 ft. deep, with slopes 2 to 1. On the Croydon Railway, at New Cross, about 5000 cu. yards slipped, and stopped the traffic, the stratum being plastic clay intermixed with strata of sand and gravel. On the North Union, the Ribble embankment 45 ft. high, principally sand, with a 20 ft. culvert, fell in; a similar occurrence, with an 8 ft. culvert and 40 ft. embankment, happened at Paddington, on the Great Western Railway. The Hanwell embankment, on the same line, about 70 ft. high, sunk about 13 ft. in one night, in consequence of being seated on a soft clay, the turf, hedges and trees were displaced at a distance of 100 yards on the south side of the line; it was remedied by weighting and increasing the ratio of the slopes, and by driving an adit to drain off the water. A bridge of 3 arches had to be taken down on the Pontop and South Shields Railway, being forced in by pressure of embankment; on the dock branch of the Brandling Junction Railway, a similar event took place. I have enumerated the above with no invidious feeling, but merely to show that a considerable allowance is due to contractors for their risk in upholding works after completion, which is now generally compulsory for the first year after their completion. In conclusion, I refer you to the quotation at the head of this paper, from Professor Vignoles, and I trust I have answered the query as to the price per cubic yard in actual pence; the Professor in a subsequent section states, "the price of earthwork abstractedly, is the amount of work that an able bodied man can perform in a day." I wish the Professor had given the amount of work done by an able bodied man, and not dealt so exclusively in generalities.

I had prepared a table of the principal cuttings and embankments on the various public works, giving the local name of each, with the length, depth, quantity in cubic yards, value of the strata, time occupied in execution, the ratio of the slopes, and as far as could be ascertained, the cost per cubic yard, as also the datum line of the several railways, and the highest summit yet overcome above the level of the sea; but I was afraid of unnecessarily occupying the pages of the *Journal* with superflous matter, and merely now state that the Northern lines are as heavy as the Southern in extent of individual knolls, as the following brief comparison will show. Northern lines;—Hartlepool, Crunden cut, 800,000 cubic yards; Clarence, Russell's cut, 400,000 cubic yards. Southern lines;—Liverpool and Manchester, Olive Mount excavation 480,000; Kenyon 800,000; Edge Hill 220,000; Ram Hill 220,000. The now almost forgotten Cromford and High Peak Railway is the most extensive in rock excavations, principally of the hardest mountain limestone, and 168,000 cubic yards have been taken from one hill; this line has more variety of strata than most others, going through sandstone, clay, clunch, shale, freestone, lime, and grit. An elaborate account is published in the Companion to the British Almanac, 1830, by Thomas Woodhouse, Esq., C. E. Extensive as the above works are, they are surpassed by Telford's canal works at Birmingham, the Bloomfield cut being 80 chains long and 90 ft. deep, containing 1,000,000 cubic yards; the Smethwick 160 chains long, 71ft. deep, and containing 4,697,000 cubic yards, and being executed in 2½ years, the slopes being 1½ to 1. I will perhaps return to this subject again, and give superintendence, account, and measurement.

St. Ann's, Newcastle-on-Tyne. O. T.

RE-OPENING OF THE TEMPLE CHURCH.

It is natural to aticipate with eagerness, and to contemplate with something of exultation, the re-opening of a long closed religious edifice; and when, as in the case of the Temple church, the charms of antiquity combine with the claims of sanctity to render laudable a liberal, yet reverent, restoration, every one must enter into the feelings, blending in some degree the pleasurable and the proud, with which the modern Templars flocked to their ancient church, so worthily honoured by its present guardians—so hallowed by associations of the past. Invested by age with no common historical interest, its site half consecrated by memories of the enthusiastic, though mistaken piety of its warlike founders—its existing form presenting a noble specimen of Gothic architecture in all its chastened beauty, its solemn dignity, and grand simplicity—it has been restored with a liberality which, lavish as it was, was not only directed by the purest taste, but controlled by the most discerning judgment; and, above all, by that deep reverence for the venerable antiquity, and that due regard for the nature and sacred character of the building, which allowed not even generosity to be misled, nor permitted an ardent desire for the accumulating of all the honours which respect could dictate or wealth supply, to alter the edifice one jot more than was requisite to lend renewed durability to its antique beauty, nor to heap upon a Christian church a too meretricious adornment. On the one hand, then, we were gratified at finding the design of the building a little changed; and that, even in details, the alterations were not only in the way of renovation, but principally, in the strictest sense, of restoration. The church is a noble exemplification of the unquestionable, but often forgotten truth, that the true sublime depends not upon size; and, that simplicity is, after all, a main element, alike in the beautiful and the grand. Nothing can be more simple, yet nothing more truly imposing—striking with a sense of blended grace and grandeur, than the interior architecture; the two rows of dark-coloured marble, rising in slender yet stately beauty like trunks of lofty trees, while the equally simple yet surpassingly lovely tracery of the arches which from their summits realize an enduring embodiment of the artless interlacing and the overhanging foliage of a noble grove. The round church at the entrance is spacious, and, opening into the body of the building, affords an unobstructed view right through to the chancel, over which and nearly along the whole breadth of that end are seen splendid painted windows, the colours of which, bright in pristine beauty, are certainly as brilliant and as beautiful as any we remember to have seen—blending in softened hues the glowing purple or the milder violet, "the cloudy crimson or the misty blue;" through which streams "the dim religious light," admirably harmonizing with the restored colours of the roof, which, with the more subdued tints of the side windows, give an air of warmth and repose to the edifice quite in keeping with the general tone of its Gothic architecture. The continuity of view, so essential to the sense of grandeur, is not broken by any obstruction, the organ being in a side recess; the pulpit and reading desk masked in the line of pillars on each side (though in the best positions for audibility); and the interior as little as possible broken up for purposes of seats—there being no pews, properly so called; the students' benches in the centre and stalls at the sides—so that the general impression, at first sight, is that of chaste and simple beauty, and every subsequent view serves to deepen the feeling of the softened harmony that pervades the whole, while over all

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[1] On the sections of railways, the formation level is shown by a black line, the level of top of ballast by a blue line, and the level of top of rail by a red line.

> ———————— "the spirit of the gray old time
> "Still breathes around the fane an awe sublime,"—

though no longer, from "the shining mail and banners free" of its early occupants "flashes the light of ancient chivalry." Everything, indeed, throughout the interior manifests a just appreciation and a constant feeling of the sacred character of a church: this is equally apparent in the studious abstinence from all inappropriate adornments, and in a careful attention to all the important accompaniments of service, as is exemplified in the liberal supply of prayer-books and bibles. The benchers have been evidently guided throughout by a desire to adopt the just medium between a meretricious magnificence, out of keeping with the character of a church, and a cold correctness, equally at variance with the majestic style of the architecture. Their aim has been to make all adornments harmonize with the spirit of the ancient design, an allusion to which was not inappropriately made by the Master of the Temple when referring, at the close of his sermon, to the restoration of the building. He deprecated (while applauding the homage paid by wealth to religion) a departure, in the decoration of such ancient churches, from the beautiful simplicity of their general design, which (he observed) in this case eminently exemplified how much better our ancestors understood the character of sacred architecture than their descendants; there should, he said, be nothing in the way of ornament calculated to attract attention too particularly to itself; while, on the other hand, there ought to be a general tone in harmony with the grand beauty of a Gothic edifice. Assuredly, the architecture of such buildings was the design of those who "dreamt not of a perishable home"—who felt that "feelings which from Heaven are shed" naturally ally themselves to sympathies of kindred, though perchance of subordinate nature;—and that while man is influenced by the spirit breathed into his "inner senses" through the medium of external objects, it might be well to enlist these influences on the side of the sacred and the eternal; and if in some sort a superstitious spirit, impelled by a natural and not improper ardour for the heaping on religion all imaginable honour, induced them to transgress the legitimate limits, and lose the distinction, severing the subordinate from the superior, theirs was an error into which, perhaps, there is less danger of our falling than that contrary one, of imagining (in the words of an eloquent living preacher) "that in religion, more than in other cases, men can be entirely independent of associations;"—of supposing (as said Robest Hall) "that there need be no very great difference between a temple dedicated to the Most High and a common building"—the mistake of thinking that it can be wrong to invest the "outward and visible" appliances of religious worship with as much of attraction as is consistent with a due sense of the distinction so justly pointed out by the Master of the Temple, who remarked that there was nothing around him which could have the effect of diverting attention from the object and design of edifices so sacred; and though, indeed, it might be that to strangers accustomed to churches of humbler architecture, there might be something at first view exceedingly splendid in the aspect of the interior, the effect of a very little familiarity would be a feeling of entire appropriateness, consistency, and harmony—

> "The arch and architrave divinely grand;
> "The fairy fretwork of the cunning hand;
> "The harmony of stone, the coloured light
> "That gleams through rainbow windows dimly bright—
> "How can we gaze, nor turn from earth to heaven,
> "As though some finer sense were newly given?"

You felt that there was nothing in all you saw about you to detract from, rather to enhance, the feelings of devotion; that it was something, at all events, if not all, to have thus ministered amid

> "The sanctities combined
> "By art to unsensualize the mind,"

incitements tending "to raise the heart and lead the will by a bright ladder to the world above;" and while listening to the "pealing organ" and the "solemn chant" of the cathedral service (conducted, as it was, in a manner so subdued and so chastened as to be enough to silence for ever the cold and shallow stigmatizers of such chanting, as necessarily savouring in any degree of aught save the harmonious and the hallowed,) its music seemed "lingering and wandering" (in Wordsworth's lovely language)—

> "Like thoughts, whose very sweetness yielded proof
> "That they were born for immortality."

You felt that these were influences calculated "not to divert, but to inspire;" that they served "without offence, to aught of highest, holiest influence" (still borrowing from the great poet of our age), but to "recall the wandering soul to sympathize with what man hopes from Heaven;" and to produce impressions perfectly consistent with the beautiful liturgy (admirably read,) and with the impressive and able discourse of the Master, which we should be desirous of describing from memory, did not respect, alike for the preacher and his theme, forbid us.

For ourselves, in the feelings which pervaded our mind at the close of this first, in (we trust) the long uninterrupted succession of future services in this noble church, where mingled gratitude to the benchers of these societies whose funds they have with so much munificence expended in this highest of all objects; and gratitude, more remote in its application, to the founders of those ancient institutions, which thus act as conservators of so much that is valuable and venerable, and whose powers are so worthily applied to the employment of wealth in a manner calculated, beyond the more immediate results of their liberality in the renovation of a building which is their noblest heritage, to afford an example worthy of every possible imitation in the restoration of similar memorials of ages assuredly nobler in their religious foundations, though not so orthodox in their religious faith as is our own; in preserving (that is) all that is valuable in legacies of the past, for purposes most sacred and most important to the present. And if the mind could not altogether exclude the recollections of those misguided warriors, whose name and whose memory yet linger on the spot which centuries ago their stern enthusiasm hallowed, it was not, perhaps, an unfounded idea that as from their church nothing has been removed that was at all necessary to the simple harmony of its majestic design, so amid the more peaceful fraternities that have succeeded them their virtues have not been discarded along with the alloy of their superstition; but that, with a more enlightened liberality, there survives among the modern Templars all the high and honourable feeling (without its accompanying delusions) which for the most part characterized the Templars of old.—*Times.*

Royal Steam Navy.—A handsome and powerful steam-vessel is ordered to be built, and named the "Trident," and it is probable she will be constructed for the sole use of Her Majesty. The vessel is expected to be ready for launching at an early period next season. The Trident will be equal, if not of larger dimensions, to the *Devastation*, and will be fitted with the compact and superior engines invented by Messrs. Maudslays and Field. The port at which she will be built is not yet known, but Pembroke has been named as the most likely place, the slips in the other dockyards suitable for building her being already appropriated for other vessels.

NOTES ON STEAM NAVIGATION.

Paddle floats are usually either of fir 3 in. thick or elm 2½ in. thick. Each float should consist of only one piece, either from being cut off a plank as wide as the float, or from the pieces being bolted together edgeways if consisting of more than one. These bolts should go right through the float edgeways with a head on the one end and clinched on a ring at the other. There should be 3 in each float, and in distributing them care should be taken that they do not come in the way of the bolts which attach the floats to the arms.

Paddle bolts and plates constitute an item of considerable expenditure, especially if the ship's carpenter is negligent in screwing up the bolts firmly. New floats are particularly liable to become loose from the compression of the timber, and the bolts should therefore be tightened on every convenient opportunity. It is not uncommon to nick the thread of each paddle bolt with a chisel to prevent the nut from unscrewing, but this will seldom be necessary if the bolts be properly screwed up. When a float is broken, which will sometimes occur in a heavy sea, some of the paddle bolts will generally be lost, but none ought to be lost from any other cause. The carpenter in getting new bolts should always fetch back the old ones, if only to show that there has been no considerable loss from negligence. On one of the outward voyages of the British Queen she lost every float on the weather wheel, and was placed in considerable peril in consequence. This we are inclined to attribute to the circumstance of the bolts not having been tightened after they had been shifted. The vessel on the occasion to which we refer had been in dock, and all the floats had been removed to enable her to go in. When she came out the floats were replaced, and we doubt not the bolts were screwed as tight as possible. This was in London: the vessel then started for Southampton, where the bolts should all have been tightened before she put to sea; but this we believe was not done, and the exposed wheel lost all its floats in consequence. Some of the floats indeed were probably broken by the violence of the waves, but the greater number we suspect were lost from the slackness of the bolts.

Against the rapid erosion of the paddle bolts by the sea water we know of no defence except frequent painting. The wheels should be well painted with red lead about four times a year. Red lead is, we think, a better protection to the iron than coal tar, and is much more manageable in its application. It will penetrate into all the joints and minute interstices which coal tar will not do, and will also adhere to the iron more firmly. Coal tar will sometimes peel off, especially if the wheel has been at all wet at the time of its application; and the iron will not unfrequently rust beneath the coal tar.

As paddle bolts are an article of large consumption, it is of course desirable to produce them with as little labour as possible. The practice of the London engineers is to wind a bar of square iron round an upright mandril fixed in the ground in the same manner as the links of cables are made, and then to cut every round of the spiral in two places; so that every round of the spiral will make two bolts. The mandril must of course be of the figure formed by placing two bolts with the point of the one touching the hook of the other. The nuts of the paddle bolts should not be hexagonal but square, and the carpenter should be provided with two or three good stout spanners that will fit on the nuts easily. These spanners should be single ended; the handles should be straight, and furnished with a hole at the end, through which a rope yarn should be rove. Whenever the spanner is used, the rope yarn should be tied to the rim of the wheel, so as to prevent the spanner from being lost should it happen to slip or fall from the man's hands into the water. Sufficient length of rope yarn should of course be left to permit the spanner to be wrought without impediment. The nuts of the paddle bolts may be quite well stamped in a die; a good stout punching press will answer very well for the compressing power.

Horses power.—There is a blessed uncertainty among engineers as to what area of piston and length of stroke constitutes a H. P.; in fact every engineer appears to have a measure of his own, whereby about as much confusion is introduced into engine making as would arise among the haberdashers if every shopkeeper had a yard measure of greater or less length than his neighbour. A horse power is as much a conventional unit as a pound avoirdupois, and we think it a disgrace to the Institution of Civil Engineers that it has not accurately defined what a horse power is. Mr. Watt, it is true, determined a horse power to be 33,000lb. raised one foot high in a minute; but, however useful such a standard may be for the power exerted by an engine with the power exerted by horses or any other species of prime mover, it is wholly useless for commercial purposes. In short it may inform you of the power actually exerted by any engine, but not of the number of horses power which a given diameter of cylinder and length of stroke are equivalent to. If a man purchases an engin[illegible]e is charged at the rate of so many pounds sterling per horse power, and how is he to ascertain whether he has that number of horses power or not? He has no means of finding out, because it has not been defined what a *nominal* horse power is, and every engineer makes it a different qu[illegible]ity. Thus the West India mail packets are all said to be of the [illegible] power, but he will be very far out who shall conclude from the[illegible] all the cylinders are of the same diameter.

Messrs. Maudsla[illegible] 400 H.P. is about 72 in. diameter of cylinder.

Messrs. Miller & Co.'s [illegible] H.P. is about 74 in., which is just about as reasonable as [illegible]e man's foot should be twelve inches and another only ten. A[illegible] a given sized cylinder, if devoted to the [illegible]opulsion of a vessel through the water, is rated differently from what it would be if used for any purpose on land. And in Messrs. Maudslay's marine engines, while a cylinder of 47½ in. diameter and 5 ft. stroke is rated at 80 H.P., if on the side lever plan, a 48 inch cylinder and 5ft. 6in. stroke is only rated at 75 H.P., if on their double cylinder construction. Such capricious variations appear to us extremely reprehensible, and are calculated, we think, to give a false impression of the force of a new kind of engine or defraud purchasers of a part of their measure in the old kind. The power of an engine ought manifestly to be some function of the cubical capacity of the cylinder, and that function should not be determined by abstract or scientific views, but by the intent to equalize the cost of production for the same power whatever be the stroke and diameter. In other words an engine of the same power should cost the same money whether its stroke be longer or shorter than that of other engines, any increment in the stroke being so compensated for by a decrement in the diameter, so as to keep the expense of production unaltered. This standard, it is true, would no longer be a measure of the power exerted, but of the expense incurred, and therefore "horses power" might be an inappropriate name for it. But the term horses power is not even now expressive of the real power an engine exerts, at least in common language. The *actual* power is sometimes determined for scientific purposes by means of the indicator, but it is by the *nominal* power that engines are bought and sold and always spoken of, unless when the contrary is expressly stated. The term horse power is therefore as applicable to the proposed new measure as to the existing one, yet we think a better term might be invented.

The following is Boulton and Watt's rule for determining the nominal horses power.

Let $D =$ the diameter of the cylinder in inches.

$V =$ half the velocity of the piston in feet per minute.

$$\text{Then } \frac{(D^2 - 4\,D)\,V}{2650} = \text{the number of nominal horses power.}$$

But how is V to be determined before perhaps the engine has been made? Boulton and Watt fixed upon an empirical velocity for each different length of stroke. The several velocities are as follow.

stroke. ft.	in.	velocity. ft.
2	0	160
2	6	170
3	0	180
3	6	190
4	0	200
4	6	210
5	0	220

And so on with 10 feet of additional velocity for every 6 inches of additional stroke. Yet this rule does not give results answerable to the dimensions observed by Boulton and Watt in their marine engines. Thus the original engines of the Thames and Shannon constructed by Boulton and Watt, were rated at 80 H.P., the cylinders being 47½ in. in diameter, and the length of the stroke 4ft. 6in. $(47{\cdot}5)^2 - 4\,(47{\cdot}5) = 2066{\cdot}25 \times 105 = 217930 \div 2650 = 83$ H.P. nearly, instead of 80. Land engines of 43½ in. diameter of cylinder and 8 ft. stroke, making 16 double strokes in a minute, were rated by Boulton and Watt at 80 H.P. The average effective pressure on the piston is rated at barely 7lb. per square inch, and the power may be thus computed, $(43\tfrac{1}{2})^2 \times {\cdot}7854 = 1486{\cdot}2 \times$ by 7 and 266, and $\div$ by 33,000 = about 80 H.P. In marine engines a greater area of piston is allowed to represent a horse power than in land engines, because the motion of the piston is supposed to be slower, but the effective force is calculated a little higher, or at 7·3 per square inch.

To heighten all this perplexity, M. Pambour proclaims to all nations that the boiler is the true measure of an engine's power, and with the forwardness proper to a little knowledge, maintains this to be a discovery of his own. All engineers and most amateurs have long known that the power produced by an engine is proportional simply to the steam expended, provided there be no accidental circumstances to influence the result, and that the piston be not made to travel at an extreme velocity. M. Pambour's discovery, therefore, contributes nothing to our knowledge of the subject, unless it be his intention to allege that the power of an engine is to be determined by guaging the boiler instead of the cylinder. If this be his aim we willingly surrender to him the full credit of the ingenious suggestion.

We trust the Institution of Civil Engineers will give their early attention to this subject, and define what function of the length and diameter of a cylinder a horse power should be, so that a uniformity of measurement may be established among engineers, and purchasers may know what they are buying. Should this not be done by the Institution we shall attempt the task ourselves—giving the proportion of our principal engineers, the rules for finding those proportions, and a new unit of our own.

Surcharged steam.—The question has been frequently raised whether steam to which a high temperature has been imparted without increasing its elasticity is more economical than common steam. The specific heat of steam has been found by experiment to be 847, that of water being 1, and if this result is to be relied on, there appears to be a saving worth attending to in the use of surcharged steam. Yet it appears questionable to us whether the specific heat of steam is not the same as water, the apparent diversity arising from some error in the experiment, which indeed in researches of such delicacy it is almost impossible to exclude. There are many analogies in favour of the conclusion that the specific heats of bodies are inversely as the atomic weights, and if that doctrine be true, the specific heats of steam and water must be the same. Yet great economy is said to have been realized by the use of surcharged steam, and upon the whole it seems worth while to inquire what amount of benefit may be expected from surcharged steam at a given temperature supposing the specific heat of steam be such as has been determined by experiment.

If θ denote the density of the steam, then $45\left(\frac{1}{\theta}-\theta\right)$ will denote the diminution of temperature when the steam is rarified to unity, or the number of degrees requisite to be added to maintain the temperature unchanged. The latent heat of steam being 1000°, the heat necessary to raise water from 60° into steam is $1000 + 152 = 1152°$, and if the steam after leaving the water at the temperature of 212° be heated to 600°, and at the same time be prevented from expanding, $600° - 212° = 388°$ = equal the heat requisite to be added if the specific heat of steam were the same as that of water. But the specific heat of steam is ·847.

$$\therefore\ 1 : {\cdot}847 : : 388 : 328$$

Supposing now the steam be allowed to expand,

$$\left.\begin{array}{r}448+212 = 660\\ 448+600 = 1048\end{array}\right\} 660 : 1048 : : 100 : 158{\cdot}8 \text{ or say } 159.$$

or the steam when permitted to expand, will occupy 159 volumes at the original atmospheric pressure. The density of the steam when so expanded will be $\frac{100}{159} = {\cdot}629 \therefore 45\left(\frac{1}{{\cdot}629} - {\cdot}629\right)$ = the heat absorbed by the steam during its expansion from 100 to 159 volumes, $45\left(\frac{1}{{\cdot}629} - {\cdot}629\right) = 45\left(\frac{1}{{\cdot}629} - \frac{{\cdot}629^2}{{\cdot}629}\right) = 45\left(\frac{1}{{\cdot}629} - \frac{{\cdot}401641}{{\cdot}629}\right) = 45\,({\cdot}598359) = 26{\cdot}025015$ degrees. This is the result for air, the specific heat of which is ·2669.

$$\therefore\ {\cdot}2669 : {\cdot}847 : : 26 : 82°.$$

The total quantity of heat therefore requisite to produce 159 volumes of surcharged steam of the atmospheric pressure and temperature, 600° is $1152 + 328 + 82 = 1562°$. To raise an equal quantity in the common way would require 1831·68°, for

$$100 : 1152 : : 159 : 1831{\cdot}68° \text{ say } 1832.$$

$$\therefore\ 1832 - 1562 = 270° \text{ and } 270 \div 1862 = \frac{1}{6.7} \text{ of the whole heat;}$$

in other words, by surcharging the steam to the temperature of 600° the saving is a little more than a seventh of the whole fuel consumed.

Deck Plates.—Every steam vessel should have an iron deck plate above the steam chest: the fore and aft bearers of the boiler hatch should also be of wrought iron. Boiler plate on edge with angle irons at top and bottom answers well. Dog bolts may still be used in the beams extending from the fore and after to the ship's side, and the knees can be placed as usual.

Safety valve chest.—The weights should all lie within the chest or within the boiler. The practice of raising the valves by palms acting on the lower extremities of the valve spindles, and attaching the weights *beneath* the valve with a cutter, which admits those weights to be raised without lifting the valve, is, we think, a good practice. The valve can thus be *eased* without opening it, which is done by relieving the valve of its lower weights, the weights *above* the valve still keeping it down, though with a diminished force. By raising the palms still more, the cutter arrives at the end of the slit in the socket, and then the valve is lifted. The safety valves seat should never be driven tight in and rivetted, but attached by means of a weak flange and a few weak bolts, so that the valve seat would be raised out of its place by the pressure of the steam before the boiler would be burst. The waste steam pipe should always be attached to the safety valve chest by a socket joint. If fixed by a flange it will speedily be cracked at the neck from the rolling of the chimney, when the vessel is in a sea way, the funnel shrouds never being so tight as to prevent *all* motion of the chimney.

Slide valves.—Messrs. Maudslays make all their slide valves up to 50 H.P., of the long D description, above that power, short D. Their long D's are just the same as those in common use, but the attachment to the valve rod is at the top instead of at the bottom as is usual. The covers of the valve casings are made so that they may be moved in as the valve faces wear, the bolt holes being oblong, and the part where the joint is faced in the lathe. The joint is made with a piece of sheet lead *not* wrapped with canvass. The valve rods are steel; the long D's are of iron, the short D's of brass. Messrs. Miller & Co. also make their short D's of brass. The practice is an excellent one.

HYDRAULIC PROPULSION ON RAILWAYS.

Of the many plans to which the fertile ingenuity of the present day has given birth, for the purpose of diminishing the cost and danger of railway locomotion, the most novel in design, and amongst the most recently invented, is the Hydraulic Railway, for which Mr. Shuttleworth, of Manchester, has taken out a patent. The principle of the invention was announced 12 months ago, but the patentee has since made considerable alterations in his original plans for carrying his design into execution. For the purpose of making it more generally known, he has just published a pamphlet setting forth the claims of his invention, describing at great length its proposed mode of operation, and calculating minutely the advantages to be derived from the adoption of this system of propulsion on railways. Independently of the ingenuity of the invention, which claims notice on that account alone, the consideration of the subject gives rise to some interesting questions relative to the motions of fluids, that well deserve attention. We propose, therefore, shortly to describe Mr. Shuttleworth's invention; to state the principal grounds and calculations on which he rests its claims for adoption; and by an examination of the phenomena and laws of hydrodynamics bearing on the subject, to ascertain whether this mode of propulsion can be rendered practically available.

The arrangements proposed by Mr. Shuttleworth for carrying his plan into operation, are in their general features similar to those of the atmospheric railway. A pipe a foot in diameter, with a longitudinal slit on the top, is to be fixed between the rails. Within this pipe a piston is to work, which is to receive the propelling impulse, and communicate it to the carriages by means of a connecting rod passing through the opening at the top of the pipe; which slit is to be kept closed by a continuous valve. So far the two plans exactly agree, and in Mr. Shuttleworth's first proposed mode of working the hydraulic railway, its resemblance to the atmospheric was still further continued. His intention was then to employ an exhausting pump, worked by a stationary engine, the pipes being filled with water. The advantage proposed to be gained by employing water instead of air in the pipes was the greater facility by which a vacuum could be obtained by exhausting an inelastic fluid. At that period Mr. Shuttleworth did not seem to have made sufficient allowance for the friction of the water in the pipes, nor for the weight of water the stationary engine would have had to drag along with great velocity. The resistance presented by these causes of retardation would, however, have required far more power to overcome than the weight and friction of a rope, the disadvantage of which it was a principal object of the invention to obviate. It is true, that Mr. Shuttleworth from the first development of his plan contemplated the occasional application of the direct pressure of a column of water, as an additional means of propulsion; but he seemed to rely principally on the power to be gained by the pressure of the atmosphere on the water forced through the horizontal pipes, to supply the place of the water pumped from that portion of the pipe in advance of the piston.

The plan of working by hydraulic propulsion now proposed, which is detailed at great length in the pamphlet before us, has effected a complete change in the mode first intended. Mr. Shuttleworth now relies entirely for the propulsive power on the pressure of a column of water, acting against the pressure of the atmosphere, without any exhaustion. He proposes to have reservoirs of water, of sufficient height to produce a pressure of six atmospheres, placed at short distances along the line of railway. From these reservoirs vertical pipes, of the same diameter as the horizontal, are to convey the water to the commencement of each section of propulsive piping. The length of each of these sections is to be about 70 or 80 yards, and the termination of each section of propulsive piping Mr. Shuttleworth proposes to connect with double its length of what he terms "skeleton piping," along which the railway carriages are to be propelled by the momentum previously acquired. In the intervals between the running of the trains, it is proposed to employ stationary engines of great power to pump the water back again to the elevated reservoirs.

The foregoing is an outline of the principal features of the hydraulic railway. The advantages which are expected to result from its adoption are, diminished cost in the mode of working, increased safety, by the avoidance of collisions, and greater facility in the construction of railways in hilly countries. Mr. Shuttleworth makes various calculations for the purpose of showing the economy of his system of propulsion compared with that by locomotive engines; but into these details we do not propose now to enter. Our present purpose is to examine the principles on which he founds the hydraulic mode of propulsion; for if these prove to be defective, as we believe them to be, it will be useless to inquire further.

The first great error into which we conceive Mr. Shuttleworth has fallen, is in the calculation of the initial velocity that could be communicated to the carriages by a vertical column of water of the same diameter as the horizontal pipe. He professes to take all his data from the best authorities in hydrodynamics, among whom Mr. Tredgold ranks foremost, and it is only due to Mr. S. to say that he claims no more in favour of his plan than the calculations of the authorities he relies on seem to warrant. His fault, like that of many other ingenious inventors, lies in the attempt to apply general principles to particular circumstances wherein those principles are inapplicable. Founding on Mr. Tredgold's formulæ, Mr. Shuttleworth estimates the velocity of water rushing from the bottom of a column 198 ft. high to be equal to 67⅝ miles an hour; this, therefore, he assumes to be the initial velocity which might be communicated to the train of carriages on the hydraulic railway. Now, granting that water would rush from a small aperture at the bottom of such a vertical column with a velocity of 67⅝ miles an hour; we cannot concede that the *whole column* would rush out with that velocity. According to theoretical estimates, water rushes from an orifice with the velocity which a body falling freely would acquire in moving through a space equal to the height of the water above the orifice; but many circumstances may cause the velocity of the issuing fluid to deviate from this general law. If the size of the aperture approximate to that of the tube, the velocity will be diminished; and if the aperture be of the same size as the tube, so that the whole column of water must fall as rapidly as the issuing fluid, the velocity will be diminished one half, without making any allowance for friction. That this must be the case will appear from the circumstances attending the fall of a column of any other body the particles of which cohere. The accelerated motion acquired by all bodies in their descent, would naturally give to the water towards the bottom of the vertical pipe a much greater velocity than to the water at the top; and were the particles of the fluid without cohesion, they would separate into drops in their fall, instead of acting in one connected column. The cohesion of the particles is, however, sufficient to prevent this separation, and the fluid column must, therefore, move with an uniform velocity, in the same manner as a chain or a rope thrown over a pulley must fall throughout its whole length with uniform velocity. The lower portions of the water or chain which, if detached, would move with greatly accelerated velocity, are retarded in their descent by adhering to the more slowly moving portions above, to which they in turn impart some of their superior momentum gained in the descent. The communication of velocity from the lower portions of the falling column to the upper is evidenced in the flow of water down pipes, by the force with which the water in the reservoir is drawn into the pipe; which force increases with the height. It thus appears, that the resulting velocity of a vertical column of water must be the average motion given by gravitation to the whole; or less than half that which Mr. Shuttleworth calculates would be the initial velocity in his system of propulsion. He might, it is true, obviate this difficulty by greatly enlarging the size of the conduit pipe, but this would materially add to the cost of construction.

Another important error appears in Mr. Shuttleworth's calculations in consequence of the velocity of water flowing freely being considered the measure of its propulsive effort. Now, it is very obvious, that any effort required to propel the train of carriages on the railway must diminish the velocity of the acting fluid; and that in proportion to the velocity communicated to the train, the propulsive effect of the fluid pressure must diminish; for it is only when the pressure is resisted that its effect operates. For example: if the carriages were propelled by some other power at a velocity equal to that with which the water rushed along the horizontal pipe, the fluid would evidently exert no impulsive effort on the piston. If the carriages were propelled with half the velocity of the fluid, then only half the impulsive effort would be exerted; and not until the train was stationary, would the full pressure of the fluid be brought to bear on the piston. The whole of Mr. Shuttleworth's calculations of the power to be derived from hydraulic propulsion would, consequently, only apply to pressure against a stationary resistance: so soon as the train was put in motion the power exerted on the piston would diminish and would continue to decrease in proportion to the increase of speed attained.

One of the objections urged against the system of propulsion by locomotive engines is the great waste of power occasioned by the weight of the engine and tender, yet Mr. Shuttleworth seems to have entirely overlooked the fact, that the same objection applies, in a tenfold degree, to his plan of hydraulic propulsion. He has, indeed, no heavy engine to propel, but the weight and friction of the water, which constitutes his moving power, offer a far greater resistance to motion than an engine and tender. The length of each section of propulsion piping is proposed to be only 70 yards, yet towards the end of that short length the weight of water to be propelled would amount to nearly 5 tons. This weight of water would have to be put in motion with great velocity, with the additional objection of being exposed *throughout its whole course* to retardation by friction in the pipe; whereas the friction of a locomotive engine acts only on those points of the rails whereon the wheels rest. The loss of power by retardation in the tube is, indeed, taken into account by Mr. Shuttleworth, but he appears to overlook the fact that this loss is occasioned by communicating motion to his moving power. The amount of power lost by propelling the water through the pipe is much greater than would at first be supposed. Mr. Shuttleworth himself estimates that his calculated initial velocity of 67⅝ miles an hour would be reduced in a length of pipe of only 70 yards, to 29¾ miles an hour; and in another part of his pamphlet it appears that the estimated initial propulsive power of 693 horses (!) would be reduced, after passing through 70 yards of piping of one foot diameter, to 71 H. P. We have thus, by Mr. Shuttleworth's own showing, a power of 622 horses absolutely lost in propelling the moving power; and that too for the short distance of only 70 yards! Surely no system of railway propulsion was ever before proposed, which by the statement of its inventor exhibited such a waste as this; and yet it is proposed as a means of economizing power!

Nor is this all. An enormous waste would arise also from the attempt to regulate the speed communicated by a power varying, by the estimate, from 693 horses to 71, in the space of 70 yards. To obviate the objection which would be urged against the plan, were the rates of speed to be so unequal, Mr. Shuttleworth proposes to fix a self-acting throttle-valve at the commencement of each section of propulsion piping, so as to reduce his estimated initial velocity of 67_{8} to 27 miles an hour. Thus nearly two-thirds of the power would be absolutely thrown away for the purpose of regulating the speed to agree with that of the terminal velocity of the water. Mr. S. appears to imagine, however, that this check on the flow of the water, would not diminish the pressure, because, according to the laws of hydrostatics, the pressure is as the base of the resistance, and that the area of the piston would therefore sustain the same pressure however small the opening of communication from the vertical column of water. He forgets that this law obtains only in fluids at rest; and that as soon as the piston moved under the impulse of the whole vertical column of water, the impulsive force would be diminished. If the throttle-valve were so regulated as to reduce the velocity to 27 miles an hour, the pressure on the piston would correspond with that velocity, and not with the pressure of the whole vertical column. All the force lost by checking the water at the throttle-valve would consequently be so much power wasted.

It might be supposed from the lavish waste of power which is exhibited throughout the whole plan of the hydraulic railway, that the inventor had at command the falls of Niagara every 200 yards of his proposed line; the waters of which he could send rushing through the pipes without any limitation. Not so, however, for every drop of water thus uselessly squandered is to be forced back again into artificial reservoirs. Of these reservoirs, indeed, though they form an essential part of his system, he makes but little mention. In the construction of a railway on the hydraulic propulsion plan, they would, we conceive, figure rather prominently among the items of expenditure, and add very materially to the engineering "difficulties" of any line of railway. The erection of immense towers 200 ft. high every 200 yards, would present formidable obstacles to the trial of such a mode of railway propulsion, even did it present theoretically much greater advantages than those claimed for the hydraulic; and unless our views are exceedingly erroneous, the plan could never be practically carried into execution, in consequence of the immense waste of power which every part of it presents. We have, we think, pointed out sufficient instances of this waste to justify our opinion, but on reading over Mr. Shuttleworth's "plain statement" others will be found which we have not thought it necessary to enumerate. Objectionable as Mr. Shuttleworth's first plan of the hydraulic railway appeared, we consider it far preferable to his "improved" mode of employing the water propulsively. The principle of exhaustion, on which it depended, is more simple, and its effects would be more certain, and produced with vastly less expenditure of power.

We regret to be obliged to decide so unfavourably on the claims of an invention which bears evident marks of great ingenuity and labour; but we consider it much more to the interest of an inventor, who has been misled by the application of erroneous data, to endeavour at once to convince him of his error, than to indulge fallacious hopes, which can only end in more bitter disappointment.

THE ARCHITECTURAL SOCIETIES.

SIR—In this age of novelty, locomotion, and substitution of new powers for those approved in days of yore, can we wonder at any of the attempts made by Ecclesiastical Commissioners, of whose "crusade against the employment of architects" T. H. W. so justly complains, or other *Joint-stock* societies, such as one recently established in the North, which professes to follow the Oxford and Cambridge architectural societies, and that they should submit to them any plans which may be made for building new churches, or for *restoring old ones*, as prepared by their builders or their builders' clerks, (for architects will be out of the question,) under their immediate *direction* and *dictation;* albeit their knowledge is obtained entirely from *Glossaries* and other books, which are *compiled* from works, *sometimes* possibly correct, but more frequently *artistical plates*, made for effect only, and when examined and compared with the work intended to be represented, cause the inquirer to think whether a wrong plate may not have been bound up with the work by mistake; there will be of course much experimentalizing by the new parsonage house commissioners, and the builders in many places will have to conform to the views of their architect, who composes his plans by the fire-side, for why need he trouble himself about local peculiarities, and what *cares he* about the gaping and wondering of the country boobies, at seeing a trim brick and plaster house, built upon a stone quarry, when the material excavated from the cellars, would have built the walls of the house at half the expense, and twice the durability; the rage is now all for a bit of Gothic, or at least Elizabethan, for possibly a work published a few years ago, (the "Principles of design in architecture,") has tended to put away the "*Gothic and tasty*" lintels cut up to a peak over a door, when a horizontal one would have been stronger and produced a better effect; formerly the indented battlement or parapet was all the rage, now the pointed gables, as irregular as it is possible to make them—one in the entrance front with windows ranged like a ship's port holes, and much in the same proportion, and the other close to it in the same line with a huge projecting chimney stack, covered with mouldings and shields, for what purpose only known to the designer. Strips of wood cut into holes of all shapes, quatrefoil, trefoil and wavy, according to Rickman, *barge boards*, (certainly as appropriate as the rest of the structure in such a situation,) placed under each of the gables—now the Architectural Societies intend to *copy* and to restore; at least *so they* say: but when are they to give their knowledge? The prospectus of the new Yorkshire Society contains the names of two architects only, and neither of them attended the Autumn meeting. *Two meetings* are to be held in the year, and from the information given at the last, it appears, that for *general accommodation*, they are to be in the remote corners of the country; all admitted must be members of the Established High Anglo-Catholic Church! the committee, of young clergymen, and amateurs, who *read*, and *look at pictures*, are to be the *bees*,[1] *if they can be got to work;* all the rest are to be considered as *drones*, and only called together in the Spring and Autumn, to see the produce of the hive. As far as could be seen after the last meeting, the secretaries constituted the society—two clergymen and a surgeon, the *latter very young*. From this society is to be *directed* the restoration of the architectural gems of the country, and woe to any architect, who dares venture upon a slight variation, if even better to remove the work of a subsequent period, and restore the earlier and better parts. It is time for the architects to awaken from their *lethargy*, or if awake, *their apathy*, as they alone can be expected to guide the uninitiated in the profession, and make them so far of use, that (as throughout the country there is a feeling in favour of the Ecclesiastical buildings of the middle ages, evidently the works of the clergy and their *free* brethren), they may work together, and discover the source from which the beauties of those temples spring.

I am, Sir, &c.,

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DR. PAYERNE'S EXPERIMENTS ON THE DIVING BELL.

[WE received from Dr. Payerne, but too late for insertion last month, a letter complaining of our remarks on his diving bell experiments. It is but fair to the Doctor to publish his reclamation, to which we shall add a rejoinder, in justice to ourselves.]

SIR—He who undertakes to treat a subject which he does not understand, is liable to fall into the deepest error. Of this truth the reporter of the experiments made by me on different occasions in the diving bell, furnishes, unfortunately for himself, too glaring an instance in the October number of your Journal. I shall not, in order to prove this, lose myself, after his example, in a maze of suppositions all equally gratuitous, not even excepting the emphatic preamble in which he exclaims against the whole English press, to whom I tender my sincere thanks for its favourable notice of the success of my experiments, a notice which has done me the more honour, as it was altogether unsolicited.

One idea in which the reporter, as he reverts to it in every line, indulges with much complacency, is the supposed pompous announcement by me of the discovery of a new process for generating air by decomposing water, and thereby producing the necessary oxygen to support life. Upon what authentic grounds, I will ask him, does he rest his pretended report? Is there not reason to believe, until he condescends to reveal its source, that he has attempted wittingly to impose upon the judgment of your readers? He indeed never will, but I can proclaim its source; he has collected his notes, not on the spot where the experiments were made, nor in accordance with the principles developed in the esteemed works upon chemistry and physiology of which he is ignorant, but in the shop of a third or fourth rate provincial chemist, a declared enemy of Major-General Pasley, who did not think fit to receive, with implicit faith, the light offered to him by this pretender. It shall be my business to show that Major-General Pasley has unvaryingly adhered to the truth, and that the reporter is egregiously ignorant of the commonest laws of pneumatics.

The diving bell in which my experiments were made at Spithead, is but 5 feet high, 4 feet long, and 2½ feet broad. The seat therein is about 18 inches above the bottom, so that our shoulders did not rise above 3 feet 3 inches. These data known, I am obliged, in order to be understood by the reporter, to enter upon a few elementary explanations upon the compressibility of air under a given pressure. It has been an established fact, since the period of Mariotte and Boyle's experiments, that all gaseous substances become compressed in an inverse ratio with the pressure to which they are subjected. It is a fact no less true, that a column of water about 33 feet high, after removal of the air above, will counterbalance the terrestrial atmosphere. But when the latter and the column of water simultaneously press with their whole weight upon a gaseous substance or upon air, it becomes condensed to one-half of the volume which is filled when subjected to a single pressure of one or other of those agents. This law once well understood, it becomes evident that, at the depth of 33 feet of water, subject to the pressure of the atmosphere, the quantity of air contained in the diving bell at the instant of immersion, will be reduced to one-half of its original volume, and that the water will rise to one-half of the height of the diving bell, namely 2½ feet. If an atmospheric pressure be added to the former twofold pressure, the volume of air, already reduced one-half, will be further reduced by one-third, that is to say, that the water will rise 10 inches higher, or 3 feet 4 inches, a height already more than sufficient to immerse us shoulders deep in the water. If to this height be added that which should have been produced by an additional column of 8 or 10 feet of water, it will be seen that Major-General Pasley, instead of exaggerating, has rather restricted facts with that reserve which belongs only to men of real learning, who advance nothing but what they are in a condition to establish beyond dispute.

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[1] The standard for all buildings is to be Parker's Oxford Glossary.

The reporter lays it down as an axiom, that one gallon of air suffices to support life during one minute. I beg of him to inform us upon what scientific authorities he rests his reasoning. Unless he dares to challenge the conclusions of the French Institute, and especially the recent experiments made by Messrs. Leblanc and Dumas, it has been demonstrated by the whole body of the learned, that a man inhales in one hour about 200 gallons of air, and that he requires 8 times that quantity in a shut up place, for the well-established reason that a portion of air issuing from the bronchia, renders 8 portions of pure air unfit for the support of life. The result from this fact is, that the diving bell of the Polytechnic Institution, containing 80 feet of cubic air only, instead of 140, as the reporter dares to affirm, or 500 gallons instead of 870, a diver, without the help of my process, could not remain therein more than 20 minutes. The pretended experiments which are alleged to have been made subsequently to mine, and which deserve to be styled mysterious far more than those to which this epithet has been so injudiciously ascribed, have been witnessed by no one; and had they really taken place, as is alleged, the actors therein must have been driven out of the diving bell by a degree of suffering past endurance, whereas in my experiments I was not sensible of the slightest inconvenience, and was drawn up without having expressed a wish to that effect, and solely because the term allotted for the experiment had expired. In a word, I can remain in the diving bell an indefinite period of time.

What would you have me answer to the absurd supposition that I profess to enable a man to inhale water at the bottom of the ocean, instead of air?

The dimensions of the diving bell at Spithead are already known. The cylinders, according to an exact evaluation, did not hold more than 70 cubic feet of air, at a pressure of 30 in., and not 220 ft., as the reporter alleges. According to the beautiful experiments of Mons. Leblanc, the whole quantity of air contained in the 2 cylinders and the diving bell would have been scarcely sufficient for 2 men during one quarter of an hour. But the difficulty of living any length of time under water was not the question I wished to elucidate or settle at Spithead, that problem having been resolved at the Polytechnic Institution. The object I had in view has been attained in the most complete manner, namely, that of proving that the diving bell being once filled with air, under a given pressure, it was unnecessary, with the help of my process for living under water, to keep up a constant supply of fresh air, for the reason, that an even pressure would keep the water out of the diving-bell during an indefinite period. These reasons alone prevented us from prolonging our confinement in the depths of the sea. The reporter has not understood them: but I can well spare his commendation, provided as I am with the honourable attestations of those eminently competent gentlemen who witnessed my experiments. Their testimony is, in my opinion, of at least as much value as the opinions of a writer who seeks information in the shop of a man who was not, as I can prove, even present at the experiments in question.

I have said enough, sir, to convince you that your reporter having rested his arguments upon a foundation avowedly unsound, all his conclusions are consequently erroneous, and that I had no need to attempt to conceal a failure, in a case where I had obtained a most complete success.

Dismissing his other assertions which are not worth contradicting, let us conclude that your reporter undertook a task above his reach in attempting to handle a question involving principles of chemistry, natural philosophy and physiology, three sciences of which he does not possess the common elementary notions; and, admitting that he may be less ignorant upon other subjects, I still claim the privilege of recommending to his notice the old adage: *Ne sutor ultra crepidum.*

I remain, Sir,
Your obedient servant,
Dr. Payerne.

[Of the tone of Dr. Payerne's letter we do not complain. He is evidently smarting under the infliction of our former article, in which was exposed the extravagant puffing his performances had been honoured with in the newspapers; and, under the circumstances, we can readily excuse his discourteous expressions. Of what we do complain are, the mystifications and misstatements by which it is attempted to convey the idea that he has made some wonderful discovery, whilst he carefully avoids mentioning explicitly what it is that he claims to have discovered, and of what the nature of it consists. It appears from the latter part of Dr. Payerne's letter, he entertains the opinion that the article commenting on his experiments was written by some one who "obtained his information in the shop of a man who was not even present at the experiments in question." We are entirely at a loss to conceive to whom he alludes, and in this respect we are as completely mystified as he could wish us to be regarding the properties of his revivifying apparatus. Our comments on the experiments at Spithead were, and professed to be, founded entirely on the report in the *Times*, which bore the character of being semi-official, and of being written by some friend of Dr. Payerne's. Our object was to prove that all Dr. P. was stated to have accomplished by the aid of his apparatus for purifying and generating air, might have been done without any apparatus whatever; and to correct the erroneous notions generally entertained respecting the quantities of air required to sustain life in confined situations. We think we completely succeeded in those objects by the statement of a few simple facts and experiments; but as Dr. Payerne now questions their correctness, we must return to some of the points advanced, with a view to set them at rest more conclusively.

Dr. Payerne adduces the authority of the *savans* of the *Academie des Sciences* against our calculations and facts respecting the quantities of air necessary to support life. We are certainly not so presumptuous as to challenge all the philosophers of the French Institute, but we may be allowed to question the inferences which Dr. Payerne draws from their researches, in favour of his own views; especially when they can be proved to be diametrically opposed to well established facts. He asks on what authority we asserted that one gallon of air is sufficient to support life for one minute; and as he appears to pay great deference to authorities, he may be disposed to admit that the names of Messrs. Allen & Pepys deserve consideration. Those accurate investigators of truth performed several experiments, with a view to ascertain the quantity of air absolutely necessary to support life; and the results are reported in the *Philosophical Transactions* of the Royal Society for 1808. We did not, however, state that one gallon of air per minute is sufficient for continued respiration, but that life might be supported by one gallon per minute for a short period. We expressly stated that the increasing deterioration of the air would render a larger quantity necessary, excepting for a short continuance, and we made ample allowance accordingly. There is no doubt that air containing a large proportion of carbonic acid gas is unfit for continued respiration, but the question between us and Dr. Payerne is, how long can a man continue to respire the same air without serious inconvenience; for on that point rests the value of his experiments as a test of his announced discovery. Even M. Leblanc, whose authority Dr. Payerne quotes, shows clearly that the supply of air deemed *desirable* is far from being *necessary*. In his memoir read to the Academy of Sciences, M. Leblanc states, rather vaguely, that the quantity of air required for healthy respiration by one person is from six to ten cubic metres per hour, yet he mentions at the same time that in the lecture room of the Sorbonne, when the windows are closed, the quantity of air admitted does not amount to one cubic metre each person. But putting aside all inferences drawn from analyses of the air, the claims of Dr. Payerne, which rest on his experiments in the diving bell at the Polytechnic Institution, must be annihilated if it be proved that other persons, without any apparatus, have remained equally long under water in the same bell. It seems that we were in error when stating the capacity of the bell to be 870 gallons. We have since measured it, and find its height to be 5 feet, and the diameter 4 feet; which give an internal capacity of about 62 cubic feet, or only 387 gallons. The space occupied by two persons cannot be estimated at less than 5 cubic feet, equal to about 31 gallons; therefore the bell, when occupied by two persons, would not contain more than 356 gallons of air. This is much less than we originally stated the bell to hold; and if this smaller quantity of air proved sufficient to support the respiration of two persons for an hour and a half, it confirms the more strongly our original position respecting the quantity of air absolutely necessary to support life. Dr. Payerne feels this, therefore he denies that such an experiment could have taken place, and even ventures to affirm that the "pretended experiments" were witnessed by no one. The experiment *was* witnessed by a gentleman who communicated the fact to us, and on subsequent inquiry at the Polytechnic Institution, his statement that the parties descended, and remained in the bell without external communication for an hour and a half, burning a candle, too, during a great portion of the time, was confirmed.

In order to remove all doubt on the subject, the Editor of this Journal was determined to try the experiment himself, accordingly he, accompanied by another gentleman, descended in the diving bell at the West India Docks, the use of which was obligingly afforded for this purpose. That bell is larger than the one at the Polytechnic Institution. Its height is 4 ft. 8 in., length 5 ft. 8 in., and breadth

3 ft. 8 in., its net capacity about 520 gallons; and the space occupied by two individuals would reduce the contents to about 490 gallons of air. To avoid any complication in the experiment by the introduction of more air than the actual contents of the bell, and the necessity of taking down cylinders with compressed air, to prevent the water rising in the bell, it was lowered so that the whole of the bell was immersed 9 inches below the surface of the water, sufficiently to effectually exclude all external air without compressing the air within too much. The experiment commenced at three o'clock, and was continued until half past four. In this time no inconvenience was experienced from the deterioration of the air in the bell, and in their opinion they might have remained at least half an hour longer, but the approaching darkness induced them to give the signal to be drawn up; having fully verified the experiment at the Polytechnic Institution by remaining, without a fresh supply of air, for an hour and a half. If Dr. Payerne has any doubt as to the correctness of the experiment, the Editor will be most happy to accompany the Doctor, and repeat it with him, or any other person he may nominate.

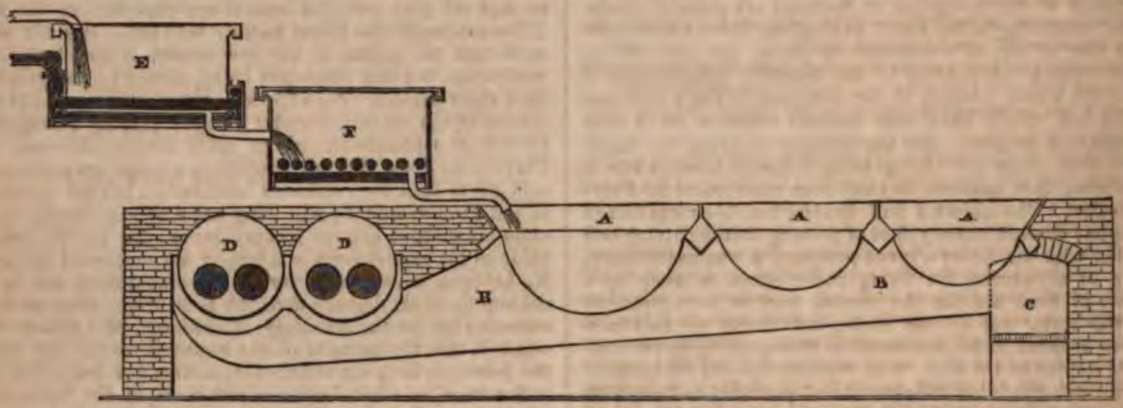
In the first of these experiments the quantity of air in the bell would allow scarcely two gallons, in the latter rather more than two gallons and a half per minute for each individual; yet those limited quantities proved sufficient, without producing any disagreeable sensations whatever.

"Facts are stubborn things," Doctor, and in this instance they will, we expect, prove too obstinate to yield to any mystification, though backed by the authority of the French Institute. No one would descend in a diving bell for fresh air, however supplied, nor select such a residence as a restorative of health; existence in a diving bell, must, after all, be a matter of endurance, and the facts we have stated show the absurdity of applying vague opinions respecting the quantity of air requisite for healthy respiration, as data for calculations of the quantity of air necessary to support life.

We infer from Dr. Payerne's letter, and from circumstances which have since come to our knowledge, that he now disclaims all pretension to generate oxygen gas, and that he claims only the plan of absorbing the carbonic acid gas resulting from respiration by the use of quick lime and potash. If this be the case, on what foundation does he rest his assertion, that he could "remain in the diving bell an indefinite period of time?" Though Dr. Payerne may, now that his experiments have been submitted to scrutiny, disclaim the power of generating "good air," there is little doubt he in the first instance wished to convey such an impression; else, by what conformity of blundering could all the reporters have agreed in so representing Dr. Payerne's powers. If he did not originally profess to be able to generate oxygen gas, what becomes of the declaration in the semi-official report, that "General Pasley had no doubt of the goodness of the Doctor's air?" and how can he defend the first proposal to descend without any cylinders of compressed air to keep out the water?

We hope we have satisfied Dr. Payerne, or at least the public, that his experiments in the diving bell at the Polytechnic Institution, signally failed to prove that he possesses any peculiar and valuable means of purifying or of generating air; and that his calculations of the quantities required for the support of life are extravagantly erroneous. We will not deny that he has done some good by the announcement of his discoveries; it has attracted attention to the subject, and thereby elicited useful and curious facts.]

SUGAR MAKING APPARATUS.



Sir—The importance of any improvement in the process of "Sugar making," in the colonies, with respect either to economy in the manufacture, or the quality of the product, I trust is a sufficient apology for calling the attention of your readers to a description of an apparatus employed by Mr. Alfred Stillman, an engineer of this city, who has for a number of years been engaged almost exclusively in the introducing and perfecting of steam machinery in the West Indian islands.

This gentleman, having occasion to put in operation a "Steam mill," in St. Croix, conceived the project of converting to the purpose of generating steam for the engine, that vast proportion of the heat from the "megass fire" which is wasted beyond the "coppers." In order to effect this, he placed the steam boilers directly behind the "trains," in such a manner as most effectively to apply the waste heat from under the "coppers." In this he so far succeeded as to require no other fuel for generating steam, than sufficient to "put the mill about" in the commencement of each day's work.

His attention was next turned to the employment of the "exhaust steam" for clarifying the "liquor." To do this, he employed tanks of sheet iron, with double bottoms and traversed by a tier of copper pipes, into which was introduced the escape steam from the engine. The process of clarifying was in this way effectually carried on; and by closing the escape pipe with a loaded valve so as to maintain a slight pressure within, the effect was so much increased, that by means of two or more sets of these tanks, the one discharging into the next, a part or the whole of the process of concentration might be thus performed, and thereby dispense with a part or the whole of the train of coppers, rendering the megass fire more effective under the steam boilers.

Now, it is a point pretty well established *in practice*, that in the evaporation of saccharine juices, the less the temperature of the heating surface, the less of oxidation takes place in the saccharine matter, and the more perfect the crystallization; consequently yielding a greater proportion of sugar and of better quality.

Admitting this, it will be perceived that if, instead of the intense heat of the megass fire and the limited heating surface, we employ the temperature of *steam* with an *unlimited* extent of heating surface, a decided advantage is gained in these important particulars—the quantity and quality of the product.

The simple sketch accompanying this, will scarcely need further explanation; being merely a section of a reduced train of coppers, A, A, A, with its flue, B, passing from the furnace, C, under and through the two steam boilers. D, D, also two clarifiers, E, F, represented, showing their construction and the manner of admitting the steam.

The whole arrangement and operation is extremely simple, and very readily encompassed by such talent as is to be found on every "sugar estate;" which has been satisfactorily demonstrated during the last two years in St. Croix, and also during the past season on the estate of Don Gasper Hernandez, Cuba, West Indies.

New York, July 1842. F. W. S.

[Although portions (if not the whole) of the apparatus above described are not new, we have thought proper to give our Transatlantic correspondent's communication an insertion, as it shows what economy there is exercised in the distribution of heat in the process of sugar making. We may at some future opportunity, publish the process of sugar making in vacuo.—Editor.]

THE PROFESSORS OF ARCHITECTURE.

1. *Introductory Lecture at King's College.* By William Hosking, F. S. A.; Architect and Civil Engineer, Professor of the Principles and Practice of Architecture, and of Engineering Constructions. London: Weale, 1842.

2. *Preliminary Discourse at University College.* By Thomas Leverton Donaldson, Vice Pres. R. Inst. B. A. &c.; Professor of Architecture. London: Taylor & Walton, 1842.

It would be unfair, at the present moment, to compare the Professors at the two rival colleges, particularly as one is but on the threshold of his career; we shall therefore consider separately, as far as we can, the discourses by which each opens the present session, giving precedence by seniority to that of Mr. Hosking. The groundwork of this is in the usual introductory lecture style, but the author has managed to introduce his favourite theories. Here he repeats his definition of a civil engineer, that he is only an hydraulic architect, and defines the duties of an architect as those of a civil engineer. Of the propriety of such doctrines we have before intimated our dissent, and also of Mr. Hosking's implied definition, that an architect is not an artist. The architect and the civil engineer have one study in common, that of construction, but they are no more identical on that ground than any two substances are identical, each of which contains an element in common. The design of a civil engineer, and consequently his career, is as distinct from that of an architect as light from dark. St. Peter's and the Birmingham Railway have masonry in common, and they have arches, yet few but Professor Hosking would propose to interchange Bramante and Stephenson. Again, we cannot but note the contemptuous terms in which Mr. Hosking speaks of the artist and of the arts.

"The qualifications of an architect—place him as far beyond the mere artist as the artist is beyond the artisan."

"Architecture and architects suffer together from their association in the public mind with the imitative arts and with mere artists."

"Artists being not unfrequently linked in the same category with players, fiddlers, and dancers."

Judges are linked in the same category with pettifoggers, physicians with quacks, and clergymen with itinerant fanatics, yet we never heard the respectability of law, medicine, or divinity impugned, or that of their professors, and we can conceive no disgrace to a man from being put in the same class with Michael Angelo, Raphael, and Rubens. Mr. Hosking, however, seems determined to treat both architecture and engineering as mere building. Another of Mr. Hosking's peculiarities is about the gentility of architects, and that at present it is scarcely a profession for a gentleman. How this may be we do not know, but we fear that at present neither lawyers, physicians, nor architects, are employed for the length of their pedigrees, the number of their quarterings, or the purity of their descent, but on account of their ability, and that their gentility is in virtue of the liberal nature of their professions. We think it much better that architects should stick to the arts instead of the Herald's College, for the present generation of architects surely cannot be accused of the sin of too much artistical feeling, which is just the quality most deficient. Public opinion and competition are especial bugbears to the Professor, and he recommends his pupils to set both at defiance. We are only fearful that if they do, they will find themselves equally wanting of reputation and employment. The present is not the period either to hold public opinion as naught, or to run counter to it; there are too many educated critics and amateurs, there is too much intelligence in the press, for the old mysterymen to hold their ground, architects must be prepared to account for the faith within them, to defend their errors as well as their merits, and to do as every other art and profession must do, look to the public voice for direction and reward. It is too late to stem the current. As to his depreciating opinion of Vitruvius, Mr. Hosking defends it, and repeats his well known assertion, that "a student would acquire as correct a knowledge of history and of geography from the 'Seven Champions of Christendom' and 'Gulliver's Travels,' as of architecture from Vitruvius." We are not surprised at hearing this, for we know a similar diversity of opinion prevails among lawyers as to the adoption or rejection of "Coke upon Littleton" as the foundation of legal studies. In both cases, however, we consider that the class book is to be esteemed as indispensable, not on account of its positive instruction (which in both cases is of little value), but as the instrument by which the minds of the profession have been moulded, and so, essential to the new student. Mr. Hosking's remarks on competition we must pass over, as also his plan, for they are so foreign to the present state of public feeling, as to be entirely futile. As to the assertion that no competition should take place between architects, because none exists among lawyers and medical men, it is quite unsupported, for a lawyer or a medical man may have a thousand cases or more in the course of a year, but few architects have half a score buildings to erect in the same period.

Mr. Donaldson begins by recognizing the importance which architecture, within the last twenty years, has assumed in this country, and the deep interest which all classes have taken in its progress, as evinced by the attention paid to it by the public press. He then takes an extensive view of the artistical triumphs of architecture, and concludes by sketching out the main features of his two courses, the artistical and the constructive. The composition is brilliant, and the range of investigation wide, perhaps in some cases too wide, but giving good earnest of the extent of the author's acquirements. We note an opinion as to the merits of Vitruvius, opposite from that we have alluded to in the case of Mr. Hosking.

The following extract of that portion of the Lecture in which the Professor takes a rapid glance of the various styles of architecture, will exhibit to our readers, particularly students, those high attainments, which so well qualify Mr. Donaldson for the responsible office he has undertaken.

> Follow me up the Nile which winds its sinuous course through 1000 miles of country, from 10° within the tropic of Cancer to the Mediterranean, presenting a line of abundance and verdure through an expanse of desert. The attention is first attracted by the Pyramids within whose dark recesses may still lie hidden all the secrets, that have hitherto eluded research, to make us acquainted with the arts, the manufactures and the science of the dynasty of the Pharaohs. Memphis and Thebes, Phyle and Abussambul offer their monolithic tombs, their immense excavations, their gorgeous temples, and superb palaces, enveloped in hieroglyphic inscriptions, which still elude our research or ill repay the indefatigable zeal, the unwearied patience and the vast stores of erudition brought to the task of decyphering them; for instead of being pictures of thought they contain the bare records of names.
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> The contemplation of these masses makes the mind of the traveller revert to the period of Egypt's ancient greatness, when she was the cradle of science to the whole world, and by her progress in the arts and letters influenced the rising genius of Greece. The intelligent observer gives order to the confused piles which lie around him, and fills up the void space from the writings of Dionysius the Halicarnanian and of Strabo. We shall attempt to describe one of the Egyptian fanes.
>
> An Egyptian temple appears to have been one of the most imposing assemblage of buildings, that can be well conceived. Avenues lined with hundreds of sphinxes on each side, led the worshipper to the sacred precinct for the distance of thousands of feet; and thus the mind, even when remote from the vicinity of the Temple, received an impression calculated to excite veneration. This avenue was terminated by a stupendous mass of pyramidal form, above 200 ft. wide and about 80 ft. high, whose enormous proportion was naught diminished by the vastness of the plan in which it stands, nor by contrast with the mountains that overhung it. In the centre of this propyleum is a door, flanked in advance by an obelisk on each side, about 90 ft. high, and beside which are figures of colossal dimensions, 45 ft. high, sitting as guardians of the sacred portal. The effect of the whole is gigantic and calculated to impress the coming worshipper with the fullest notions of his insignificance in the scale of material nature. The triumphal gateway being passed, a magnificent court meets the eyes of the beholder, having on each side a colonnade; and this court led to a densely columned hall or vestible, under the shades of which the crowds of Egypt's sons and daughters reposed to recover from the exhaustion and fatigue caused by their journey under a burning sun to the fane of their creature god. And here the mind also dwelt awhile on the first impressions produced by the contemplation of the overpowering majesty of the gorgeous mass. For the huge popylea, which enclosed either end of the court, and the hall with its forest of clustered columns, which the eye could not number, and the playful variety and copiousness of channelled hieroglyphics which left not a space uncovered, and the brilliancy of the pigment which gave an endless variety to the shafts and capitals of the columns, to the beams, the walls and ceilings, bewildered the attention, and left not a moment of repose to the wondering stranger. A lofty central avenue of columns, above 60 ft. high, forming as it were a triumphal way, leads under a third portal, of dimensions by no means inferior to the others just mentioned, and marked with what care and with what sanctity the priests guarded every approach to the inner parts of the temple. But this gateway passed and a scene the most sublime burst upon the view. An ample peristyle, much larger than the one already passed, presented itself to the eye, probably planted with trees, crowded with metaphoric statues; on either hand a double avenue of columns less for convenience than dignity of effect. In the centre uprose the portico of the mass of building, which formed the Temple itself—the columns in dimension more lofty, in decoration more rich, in proportion more graceful than those of the courts. The dynasties, that had ruled over the country up to the period of the erection of this temple, have their histories graven on the walls and on the columns—the same pyramidal form gives an appearance of endless durability to the mass, which is surmounted by an immense hollowed cavetto having the centre occupied by the sculptured form of the agatho demon, or winged globe and

serpents, with outstretched wings extending over the centre intercolumniation of the façade, and seemingly a being of another world. Admitted beneath this porch, the minds of the worshippers are prepared for the gloomy inner penetralia, where every object was mysterious and emblematic. Numerous doorways closed by curtains succeeded each other, and led from vestibule to vestibule, which hindered the eye from penetrating with sacrilegious gaze into the inmost sanctuary, all access to it being forbidden to the multitude. To these vestibules the light of day was denied, and the mind was subdued by the gloom of the spot: for the attention was absorbed by the contemplation of the sacred mysteries of the place, and by the effects produced on the attention by the huge incongruous figures of granite—monstrous reflections of the gloomy minds of the religious inhabitants of the sacred precinct, who sought to deify matter and the animal instincts. How sad a contrast, that they, who by their mental powers could command such mechanical forces and make such progress in art, should be so debased as to worship the human form distorted by the addition of the head of a bird, of a cat, of a ram, or some such brute object.

We thus see the impressions which Egyptian architecture is calculated to produce, realizing the definition of beauty given by Aristotle, who says that it consists in magnitude and order.—*Το γαρ καλον εν μεγεθει και ταξει εϛι.* Poet. p. 2, § 4. One of the temples of Thebes exceeded 800 ft. in length by nearly 300 in breadth exclusive of the avenues which led to it. This vastness of extent in the plan;—gigantic grandeur in the ponderous masses;—colossal proportions in the details;—a rapid succession of similar objects;—the brilliancy of the gold, purple, scarlet, azure, green, and every splendid colour that shone upon the surfaces of the stone;—liable as all this may be to the charge of monotony, yet a series of lively impressions must have been extorted by the grandeur, the pomp, and profusion, which these imposing edifices offer to the bewildered attention. * *

Who would brave the sandy wastes of Syria, unless impelled by a glowing love for that sacred volume which records the history of the favoured race to whom were confided the oracles of divine truth, were it not to visit the Decapolis still profuse with architectural remains, almost unexplored, certainly unillustrated. Would the traveller quit the fertile and sublime valley of Baalbec, whither comparative ease and comfort have hitherto accompanied him. Would he plunge into the dangerous track of ancient commerce, beset with hordes of Arab robbers, deprived of every convenience and means of subsistence, but that which he carries with him, were not his privations, his anxieties and his perils to be rewarded by the sight of that which was once Tadmor of the desert, the Palmyra of Zenobia and Longinus. These vast piles of ruins seem the works of those days when "Giants were on the earth" rather than the production of a race like ourselves. Temples enclosed in courts seven or eight hundred feet square, surrounded by circumambient porticos of colossal dimensions—now inhabited by a score or two of wretched families in their mud cottages—avenues of columns, miles in length—a profusion of triumphal arches, lofty towers and tombs, and marble beams in single blocks of 70 feet in length attest the mechanical skill, if not the pure taste of its ancient merchants—for it was a race of merchants who dwelt in this emporium of the commercial traffic from the East, at that time forming the halting place for the caravans, which poured forth the riches, the refinements and the productions of India to gratify the craving appetite for variety and luxury of the pampered nations of Europe.

But let us accompany the traveller in his circuit of these shores and examine with him the coast of Caramania, and we shall find it abounding in a profusion of architectural embellishments. But as soon as he reaches Gnidus, sacred to the queen of love, monuments of the refined taste of the most refined periods again offer themselves, and the ruins of temples, propylea, theatres and in fact every species of edifice offer themselves to notice in Halicarnassus, Miletus, Priene, and Magnesia and the numberless cities which peopled each side of the Mæander, the Nile of Asia Minor. Still further north, Teos and Smyrna, Pergamus and Sardis show how truly architecture flourished under the fostering generous splendour of the great Alexander and his successors.

But the traveller, whose mind is imbued with all those associations connected with the study of the literature of Greece, visits Athens as the zealot does the shrine of his saint. When Europe was roused from barbarism her first thought was directed to Athens—"What is become of Athens?" was the universal cry, "and when it was known that her ruins still existed, the learned and ingenious flocked thither as if they had discovered the lost ashes of a parent." (Chateaubriand: Voyages.) When the traveller treads the soil, which had been for so many centuries polluted by the presence of the Moslem, all his feelings arise with double force. He thinks that he now breathes the same pure air, fixes his glance upon the same enchanting scenes, contemplates the same noble monuments, as once did Pericles, Socrates, Demosthenes, Xenophon, Thucydides, Sophocles, and Plato. Possessed however as are his feelings with such thoughts, his attention is more than divided by these majestic ruins, which throw around the spot an air of sanctity. Here Phidias has still his chefs-d'œuvre, here the genius of Ictinus still reigns pre-eminent, and the space encircled by the walls of the Athenian Acropolis may be termed the *ιερον* of architecture, containing temples, altars, statues, groups, trophies, chapels—the spoils of their enemies and the plunder of their allies and friends.

See how much Athens gains upon the affections of every people, of every age, by her architectural ruins. Not a traveller visits Greece whose chief purpose is not centred in the acropolis of Minerva. How different from this the renown derived from arms alone. "While the name of Athens is in every mouth," exclaims Chateaubriand, "Sparta is totally forgotten. Sparta in arms the rival of Athens—the cradle of warriors—the school of hardihood and all the sterner virtues of humanity. But she disdained the accessories of our art, and not our art only, but of every other, for she never offered the smallest incense in the temple of genius, nor on the altar of the arts. In fact, to use the words of one of Sparta's warmest panegyrists, the Lacedemonians drove away from her walls literature, science and the arts, and now not a single monument arrests the steps of the traveller. Civilization is now as far distant from the Eurotas as in former times, and he hurries from the unfriendly spot having cast a rapid glance upon a plain, where nothing records the existence of former times, and a mound at best reminds one, that here has been a city. Even the haughty spirit of the Romans bowed before the mighty influence of the superiority of Athens in art, science, and literature. When Greece was conquered by Rome, Sparta became a mere province, but Athens although depressed, a slave and helpless, without her Pericles, her Phidias, her Ictinus, her Demosthenes, her Sophocles, still asserted her mental superiority, and held in slavery the proud spirits of Rome her conqueror.

> "Græcia capta ferum victorem cepit, et artes
> Intulit agresti Latio."—Horace Epist. lib. 2, ep. 1.

What trial can equal this of the fine arts. O! could the Spartans of old have thus looked into futurity, and they would have emulated that bright love of art to which ancient and modern Athens now owes so much of her perennial glory—for as the refined and accurate Barthélémy has justly and eloquently observed, "the history of the monuments of this people is the history of their exploits, their gratitude and their religion."

But perhaps the attention is wearied by dwelling so long on this portion of the subject, and yet it is impossible to omit all reference to Rome as she is. It is there that a willing homage is yielded to the architecture of ancient periods. The soil which time has accumulated upon her ancient pavements is now being cleared away. Each excavation brings to light some precious fragment, some interesting object connecting antiquity and modern times. Her fora, her temples and circuses; her triumphal arches and lofty sculptured columns; her aqueducts and baths; her palaces and amphitheatres are now minutely investigated by the antiquary, the scholar, and the artist. Hundreds flock annually, less to witness her pomp of religious worship than to imbibe, at the very fountain head, a true love for achitecture and a refined taste to appreciate all the excellencies with which the eternal city abounds.

Nor shall Pompeii be altogether unnoticed—hid for centuries from the view of man—her site questioned and her very existence almost doubted as the fable of historians, the ashes are now removed from the tomb in which she had lain for above 15 centuries, and the traveller fancies as his footsteps are echoed through the tenantless fabrics, that the next moment he will see her ancient citizens emerge from the courts of her dwellings, from the shops of her insulæ, or from the baths, which still preserve traces of almost recent occupation. It seems as though it were but yesterday that her thousands flocked to the fora, temples, and theatres; and the spot brings us in almost immediate contact with the inhabitants of the olden times. * *

Such then are the emotions inspired by the ruins of the ancient monuments of architecture, and such the claims she has upon the gratitude of ancient and modern times, as forming one of the main links, that unites us with those, who have gone before us. Languages become obsolete, but the language of architecture endures for ever. The pages of history may be lost or destroyed, but who can for a moment admit the thought that time can obliterate, although he may deface her monuments. The pyramids and temples of Egypt are imperishable. The habits, the customs, the religion, the wants, the luxuries of man change with each century and with each clime, but for all and every new necessity and fresh desire architecture amply provides.

But in thus rendering the homage due to ancient art it were unjust to pass without notice those sublime edifices due to the genius of our fathers. It is now unnecessary to enter upon the question, whether the first ideas of Gothic architecture were the result of a casual combination of lines or a felicitous adaptation of form derived immediately from nature. But graceful proportion, solemnity of effect, variety of plan, playfulness of outline and the profoundest elements of knowledge of construction, place these edifices on a par with any of ancient times. Less pure in conception and detail, they excel in extent of plan and disposition, and yield not in the mysterious effect produced on the feelings of the worshipper. The sculptured presence of the frowning Jove or the chryselephantine statue of Minerva were necessary to awe the Heathen into devotion. But the presence of the godhead appears, not materially but spiritually, to pervade the whole atmosphere of one of our Gothic cathedrals.

This style, which has aptly been termed Christian architecture, has produced edifices of all descriptions, not only ecclesiastical but civil, evincing great variety and originality; so numerous that we cannot but feel surprised at the public spirit, the devotion and liberality, which could contribute the means requisite for such vast buildings, and at the skill that could, with a hardihood verging on infatuation, so daringly sport with danger, and yet inspire confidence in the wildest flights of Gothic fancy.

GRADIENTS ON RAILWAYS.

The readers of your valuable Journal will, I have no doubt, be aware that, but a short time since, the opinion of many, if not most, of the eminent engineers of the present day, was, that gradients only of the very first order ought to be employed in the construction of railways intended for passenger traffic, whatever might be the consequent cost. Under this impression we have now completed in this kingdom some of the most magnificent and easy lines of railway in the world, for instance the Great Western, and many others, on all of which, though, it must be owned, that thousands upon thousands of pounds have been expended in order to attain such perfection in gradients. This supposed absolute necessity for easy gradients seems now, however, to be fast losing ground with many of our first engineers, and the result of past experience seems now to say, that "one may pay too dear for one's whistle." So great have been the improvements in the locomotive engine within the last few years, that in the construction of railways at the present time, instead of aiming at absolute perfection in levels, our ablest engineers are now looking more at the original outlay, and the purchasing of good levels only at what they are *really* worth.

For improvements in railways and locomotive engines, people now, however, generally look to the south, instead of the north of England, and in many cases rightly so too, because the improvements in the north have been transferred to the railways in the south, and these improvements have, in some instances, been improved on again; yet methinks the *hot-bed* of railways may still be inspected with profit by an inquiring mind, neither ought one to be disrespectful towards the birth-place of railways, or to pass by unnoticed that part of the kingdom where the locomotive engine, rude as it was at first, came from its maker's hands a hideous monster, alike the terror and wonder of every spectator,—I mean the counties of Northumberland and Durham. And to show that gradients which, by many, are condemned as impracticable for the use of the locomotive engine for passenger traffic, may still be employed where the nature of the surrounding country forbids an alteration for the better, I will state a few particulars as to the work performed by that beautiful machine the locomotive engine, on one of the northern lines, viz. on the Hartlepool Railway.

In the year 1832, an act was obtained for the making of the Hartlepool Railway, and at that time the science of railway engineering had hardly advanced so far as to demand such absolute perfection of levels; consequently, the Hartlepool Railway can by no means be classed amongst the number of those possessing gradients and curves of the first order. The railway was certainly not made to suit the peculiarities of the locomotive engine, consequently the locomotive engine has been obliged to be made to suit it, and upon it may be daily seen a single locomotive engine, with its train of carriages, running up a gradient of 1 in 34 for a mile and a half, at the rate of from 25 to 30 miles an hour, and, notwithstanding all the inferiority of gradients, the passenger trains on this railway equal in speed and punctuality any of the more refined and southern lines.

The length of the main line over which the passenger trains run is 12¼ miles, and in this short distance it rises nearly 450 feet. For a mile and a half there is a gradient of 1 in 34, and the prevailing gradients for the remainder vary from 1 in 164 to 1 in 274. The gross load, including engine and tender, varies from 35 to 40 tons, and the number of passengers in each train from 60 to 100, and occasionally 120. The engines, "Albert" and "Victoria," with this load mount with ease this tremendous gradient, and I think it may be fairly said that for *hard work* their Majesties set an example worthy of imitation by their subjects both far and near. A few remarks also as to the other traffic on this railway may, perhaps, be worth a passing notice. The number of trains (exclusive of passenger trains) that pass along this railway in a day varies from 60 to 120, and at times amounts to 140. The time occupied for the transit of this enormous traffic is about 13 hours per day, or an average of a train in every 5½ minutes to 11 minutes during the day. The gross weight that passes over the rails varies from 7 to 12 tons per minute for 13 hours per day, and occasionally, during the present year, it has exceeded an average of 13½ tons per minute for 13 successive hours! What but an *iron* road could withstand such a traffic as this. So that, instead of the passenger trains on the Hartlepool Railway meeting with peculiar facilities, both as to gradients and non-obstruction in consequence of heavy traffic thereon (as the charge for fares would seem to warrant), the reverse is the case. Seldom during the running of the passenger trains are there less than six other trains on the railway at the same time, in the first four miles. So that what with the engines having to wind their way through this labyrinth of engines and trains, and at the same time to encounter gradients that would frighten some of the first engineers of the day, the passenger trains are performing daily, unheard of and unnoticed, on the Hartlepool Railway, what may be safely said is not being performed on any other railway in the kingdom, and probably in the world, and that at a charge, too, to the passenger, very considerably lower than on other railways possessing gradients so immensely superior. The table underneath shows the comparative cost per mile of travelling on the following railways, and without further comment thereon for the present, I will conclude these remarks :—

		1st class.	2nd class.	3rd class.
London and Brighton	..	3·44	2·26	1·42
London and Birmingham	..	3·20	2·13	
Great Western	..	3·05	2·13	1·27
Hartlepool Railway	..	1·47	1·22	0·81

S. T. N.

SCHOOLS OF DESIGN.

Sir—In the Somerset House Drawing Book, No. 1, it is laid down :—

1st. That ornamental art, as an imitative art, ranks midway between fine art and mechanical art, and partakes of the nature of both.

2nd. That the fine arts, in dealing with poetry, history, and moral expression, occupy a ground *in which the ornamentist has no right to enter!*

And yet thirdly, that *on beauty*, the artist and ornamentist occupy the *same ground!*

Again, the author says the power of imitating objects artistically, is not adequate to the ends the ornamentist has in view, and yet at page 3, the author says, "It is not merely with lines the ornamentist has to do, he has often to represent the colour and effect of metallic substances, the glitter of gems, *in short to make a picture* of the article manufactured, which shall show its general character and appearance, rather than the exact details of its form and ornament, and *there is no other way of acquiring the power of doing this, than by the habit of copying, as an artist, the objects themselves or similar ones.*"

Again he says, the ornamentist arrives at practice through science—the artist to science through practice.

And yet he says in the same page, "a saving of time would be effected, if the chief labour at commencement were bestowed (by the ornamentist) *on drawing by the hand!*

In reply to these inconsistences, I beg leave to state that—

1st. The ornamentist and the artist, both express their thoughts and inventions by the mechanical operation of imitating natural objects by form, colour, and light and shadow. Imitation of natural objects is, therefore, the basis of both ornamental art and high art, and the easiest plan of practising the eye to see, the brain to conclude, and the hand to obey, is the best plan at the beginning, both for ornamentist and artist.

A student may puzzle his memory so long by scientific distinctions, if he begin by science, as to find when he has acquired science his hand perfectly helpless ; and, therefore, both in the case of the ornamentist and artist, *a certain degree of purblind practice* of hand, eye, and brain, is absolutely necessary for the highest genius in each department, as well as the humblest, so that when their minds comprehend any principle of science, or any object of nature, their hands may at once be able to illustrate them by design.

No great artist of the Greek and Italian schools was considered a great artist without science, and no great ornamentist was considered a great ornamentist unless he was a great artist too. Raffaello was a great ornamentist ; Giovanni d'Udine, and Cellini, were artists as well as ornamentists, and the foundation of both characters is first, *a power of imitating* what you see.

There is no doubt the imitation of senseless angles and cones, and octagons and pentagons, may generate a dead sort of mechanical imitation, but *the mind* of the mechanic and artist sleeps, because there is nothing whatever to interest their sensibilities in the progress ; give them beautiful eyes, their sympathies are excited, and the circle and ellipsis being portions in the shape of eyes, they acquire the same power of imitation, and exercise their powers of thinking too—follow eyes by the nose, they learn the perpendicular—let them then practice the mouth, they are obliged to make it horizontal, or at right angles with the perpendicular of the nose ; the shape of the head is an ellipse, the forehead and chin, portions of the circle.

A human head is thus got through—combined with a human look, and a human expression ; the students *feel* as they proceed ; what practice for geometrical designs is left out in the figure? Then come action, repose, intention, and thought, by circles, ellipses, angles, and perpendiculars, but combined as a whole to convey a meaning ; when the artist and mechanic are got thus far, show them if you please, where is the geometry of the head and figure, practice them in angles and circles, that they may know their meaning; make them both men of science, if you like, and let the mechanic begin to branch off—but begin with making both skilful in hand, eye, and brain, by imitating the same object, for according to our author at Somerset House, "*a saving of time would then be engendered, if the chief labour at first were drawing by the hand.*"

If the power of imitation be the first power to be acquired, as I have proved, both from what I have said and what our opponent says, why separate the education of artist and mechanic? But what will you say, or he say, when he acknowledges that in the most important of all qualities of design, viz., *beauty*, the artist and mechanic stand on the *same* ground, and yet he would separate their education? And though he admits, page 1, they stand on the same ground, yet, he again says, they proceed to exhibit beauty by *a method totally the reverse to each other!*

"Beauty," says he, "with the ornamentist, is a quality separable from natural objects." I reply *it cannot be*. Beauty, with the ornamentist, from whatever form taken and applied, excites the emotion in the work of the ornamentist, not because it is separated from the object to which it *naturally* belongs, but because to whatever object applied, it has the power of again exciting the emotion, as it did when a component part of its natural object at first.

If a sculptor, says he, makes a lily, he models a lily. "Not so the ornamentist—the lily appears in his hands with a *new individuality*." Of course, but it is still a lily—the ornamentist makes it a cup, a vase, but I reply it is still a lily turned into a vase and cup—and if it be not like a lily, what would a sensible master say to a mechanic who showed him a cup made of a lily. "A lily! it is not a bit like a lily. Pray did you model a lily, or draw a lily?" "No Sir, I did not, because *we* ornamentists treats lilies with a *new individuality*." Very true, my pupil, but to be able to give a new individuality to a lily, you must first be able to form a lily in clay, or by drawing; to model or draw a lily, you must get a lily and study it; after studying it, you must imitate it by modelling or drawing. Imitation is the foundation of all arts or design, whether for the artist or ornamentist, and though the ornamentist turns a lily into a new office, if he cannot imitate a lily or a human figure, somebody else must be employed to do them for him, and this must prove to you, my pupil, the necessity of the ornamentist and the artist beginning alike. Because what applies to the lily will apply to the figure, and the arguments are as good in one case as the other, and both prove the same truth.

The author proceeds to say "that the ornamentist and the artist are imitators of nature, but in different senses—in the one, the resemblance is fictitious, in the other a reality." I reply the resemblance in both is fictitious, and in both a reality, though the application is different.

The basis of all this sophistry is simply this: the London leading artists had been so accustomed to be by their rank, their payment, their honour, and their privilege, *a distinct class*, that they were shocked by any attempt to revive the old connexion between artist and artizan. It was a sculptor, though rising from humble but respectable parents, who first intimated the insult of giving the artizan an education, which would rank him more as an artist than, for 300 years, he had hitherto been in England, and, of course, without any imputation on the honourable motives of any one now; we all know there is a degree of sensibility as to duty, in defending the views of our superiors, if to them we owe our station and our existence in life—it is right it should be so, perhaps I do not know if one is not inclined to respect gratitude, if even it lead a man into the most egregious folly.

It is a question, if the education of the mechanic be not of more importance than the great artist's. See how he worms himself into all the ramifications of domestic decoration, and consider, if he had, like the German and the Frenchman, the power of conveying his thoughts by drawing the figure, how prettily, at a little cost, the drawing-room of the middle classes, or their parlour, or their bed-room, might be made vehicles of history, and poetry, and design. The more the power of design is diffused, the greater, and not the less will be the employment of the great painters. The wealthy and the noble will always have the best of everything, and they who love the handsomest women, drink the best wines, ride the best horses, and claim the highest stations, will not be very apt to desert the best artists, when they want their efforts. I am decidedly of Burke's opinion, "whatever turns attention to art, even the purchase of old pictures," said he "reflects again on modern painters."

Never, I assure you, was British art in greater danger than now. This London school, by separating the artist and the mechanic, and promulgating the doctrine, that sound art and decorative art are distinct, will, in all probability, do more mischief than a century will remedy—because the facility of admission is great, young artists go to it, and all the horrors of gaudiness, glare, hardness, and false taste, will spread like wildfire amongst the rising generation.

What reason can be given, that a flower should look in decoration like botanical preparations, pasted flat on lime? Distinctness is necessary, of course, but why cannot imitations of nature be distinct, without being inconsistent with the eternal principles of the great masters, established by the greatest geniuses the world ever saw.

Titian, Velasquez, Rubens, Rembrandt, and Reynolds, made their imitations of nature on the basis of the philosophy of human sensations.

Equalities of effect distract! variety is necessary, but if carried too far, pains. It is the same with every quality of imitation in the great works of the great masters, no individual requisite of imitating life is ever obtruded, whereas, by the separation of the education of the artist and the mechanic, the imitations of the mechanic at present are all obtrusion and totally inconsistent with sound art. If a race of this offensive description issue out, as designers for glass paintings for rooms, for halls, what will the art be like in a few years? The combination of sound art can be seen to perfection in a glass window at Liverpool, where a fine picture has been copied, with all the principles of imitation; it is a fine work of art in manufacture, and that is what should be the object in all Schools of Design.

Not long since, returning from Windsor, I went into the coffee-room of the Royal Hotel, at Slough, and found the paper on the walls full of pretty designs, from Faust (I believe). "Is this English," said I. "English," said the waiter, with an air quite insufferable, "French, sir, of course!" Here is another case in point. Had the same principles of educating the mechanic been acted on at Lyons as in London, would this French artizan have been able so to please us in the middle class by such a display, and is not every visitor excited and improved by such a simple way of recalling the scenes of some beautiful poems?

I apologize for this long intrusion; my engagements preclude the possibility of continuing this important question, but I promise it shall not rest whilst I live, for I know its vast national importance and that we have only to add mastery to design to our indisputable quality of material, to take the lead in the world.

In conclusion, I deny in toto, that the mechanic has no right to mingle history, poetry, and moral expression, in his manufacturing design; what right has any man, or any body of men, to fix a limit to the exercise of human ingenuity? The Almighty sometimes gifts a Byron, and sometimes a Burns, and reflects on the principles of our own noble aristocracy. Who, more tenacious of their rights, but who more useful as a check on the Crown and the people? and who is refused admission into their class, even from the *humblest* amongst us, if genius, guided by conduct and decorum, prove any individual worthy to be a great lawyer, soldier, sailor, or statesman? If it were not for this wise decision, what would have become of the Aristocracy long ago?—and with such an aristocracy in Government, are we to establish one in art, where no genius, no decorum, and no conduct, will procure elevation and reward for the humble mechanic? Ridiculous—the bare thought and promulgation will make us the laughter of Europe, if this preface has not done so long since.

The artists must become more workmen, and the workmen more artists, before the great revolution, beginning will begin aright; but it will not be by putting forth theories which will separate them more and more than ever, but by being convinced, as the great Continental schools have long been, that as imitation is the basis of both arts, the students in each should begin alike.

At the revival of art in Tuscany artists were artificers, and artificers were artists, in the strictest sense of the words. "It was not in the academy, but in the workshop, their genius was nurtured—the *arte degli orefici*." "The goldsmith's craft was the chiefest school; hence came the best artists of all the three arts of architecture, painting, sculpture—Brunelleschi, Ghiberti, Orcagna, Luca della Robbia, Massolino, Ghirlandaijo, Pollajuolo, Botticelli, Verrochio, Francia, Finiguerra, Andrea del Sarto, Baccio Bandinelli, Cellini, Salviati, Lioni, Vasari, and a host of inferior names, all were brought up to this good trade.[1] Painters were chiefly employed as decorators of houses and furniture, &c." In all the associations of artists, trunkmakers, varnishers, saddlers, cutlers, and all workmen in wood or metal, whose crafts had any connexion with design, were admitted; and yet in England they are to be separated in education!

I think, therefore, that there is nothing "very erroneous in saying that the power of imitating natural objects artistically, ought to be the first requisite in the education of the ornamentist, or that the artistic imitation ought to begin by the human figure, since the mastery of this would render every other attainment comparatively easy."[2]

To conclude, the error of the First Council of the London School of Desig was this;—viz., adopting the German instead of the French principle in educating the mechanic. The French begin by the figure and sound art—and the artizan thus educated carries sound art to ornament. The Germans begin by ornament, and make the figure and sound art the second step—and the Germans never recover the false taste of their education.

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[1] Murray's Hand Book to N. of Italy.

[2] Drawing Book, page 2.

It is not yet too late to remedy this great mistake, by passing a law in the Council that every mechanic, as at Lyons, should be obliged to begin by the figure; and *if this be not passed,* I predict a corruption of taste in artizan and artist, which will throw the art into hideous confusion for years.

London, Nov. 7, 1842. B. R. HAYDON.

ON THE RELATIVE PROPERTIES OF IRON,

Made by the use of Cold and Hot Air Blast, in the Smelting Furnace; lately read before the West-Riding Geological and Polytechnic Society.

By Henry Hartop, Civil Engineer and Mineral Surveyor.

In the early part of the year 1829, the use of hot air in the smelting furnace, for the manufacture of cast iron, was introduced at the Clyde Iron Works, near Glasgow, and at the fourth meeting of the British Association, held at Edinburgh in 1834, Dr. Clark gave an account of its success as follows:—

That in their previous operations with cold air, 8 tons, 1 cwt., 1 qr. of splint coal (made into coke, at a loss in weight of 55 per cent.), were required to make 1 ton of iron.

With the use of air heated to about 300° Fahrenheit, 5 tons, 3 cwt., 1 qr. of coal (in coke) produced a ton of iron, in addition to which, 8 cwt. of coals were used for heating the air.

In 1833, the temperature of the air used being 600° Fahrenheit, it was found that raw coal (not coked) might be used, which circumstance further reduced the quantity of coal required in the furnace to 2 tons, 5 cwt., 1 qr. per ton of iron made.

Not having been present at Edinburgh, on the Association's meeting, the following year, in Dublin, I stated that the case had not been correctly represented to Dr. Clark,[1] inasmuch, as for some time previous to 1825, a saving in the coking operation had been made at every well-conducted iron work, by which a ton of iron could be made with 5 tons of splint coal in the furnace, when cold blast used, so that in reality a saving only took place by increasing the temperature of the air, so far as to enable them to use coal uncoked in the smelting furnace, from 5 tons to 2 tons 15 cwt., or 2 tons 5 cwt.

The account, therefore, as regards economy, by the use of hot air, will stand thus:—

	tons.	cwt.	*s.*	*d.*	£	*s.*	*d*
Saving in coal used in the furnace	2	5	5	0	0	11	3
In Coker's Wages . . .					0	2	3
					£0	13	6
Against this may be set down—							
A greater quantity of ironstone used per ton of iron made . . .	0	3	8	6	0	1	3
Extra wear on ditto . . .					0	3	6
Coal to heat the air used . .	0	8	2	0	0	0	10
					£0	5	7
Saving in materials by the use of hot air, per ton of iron . .					0	7	11

To which saving may be added a further sum of 4*s.* 7*d.* per ton, for the greater quantity of iron produced from each furnace, when hot air and coals are used, making the total saving of 12*s.* 6*d.* per ton of pig iron.

But in 1835, the deterioration in the value of iron so made was about 17*s.* 6*d.* per ton, as I stated at Dublin, and at the present time. (March 1842,) I have no recantation to read so far as the above observations go.

In Dublin my observations on the deteriorated value of hot blast iron in the market of 17*s.* 6*d.* per ton were contradicted, but after seven more years of unceasing application, practised in the manufacture on a very large scale, of numerous experiments by indefatigable practical men of great ability, of the attention of learned professors of chemistry, mineralogy, and geology, together with the aid of that no inconsiderable engine the public press, the price of pig iron so made is 32*s.* 6*d.* per ton below that made by cold blast in the smelting furnaces.[2]

If you ask why iron so made is sold for 32*s.* 6*d.* less in the market, the answer is 1st, "its great weakness under *impact,* and therefore its total unfitness for most purposes in which the greatest weight of iron is used.[3] 2nd. Its greater loss in remelting in the cupola of 2 cwt. per ton. 3rdly, The great irregularity in the contraction of castings when cooling, if made from hot blast iron, on which account many castings of different sizes are produced from the same pattern, causing great expense in their after fitting, or if this expense is not incurred, great defect in all machinery, &c., so made. 4th, Its unsoundness, that when made into castings require to be turned, bored, or planed, &c., on which occasions, if the surface operated upon is not defective on its entire area, a defect so considerable will show itself, probably when nearly finished, that both the casting and the great expense bestowed upon it will be thrown away, and in many such cases the expense of making the casting itself will be at least three times greater than even the present great difference in the value of the two kinds of iron.

I need not unnecessarily occupy your time further than by going more fully into the first of these points, the great weakness, under impact, of hot blast iron.

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[1] A similar misrepresentation has also been made to Mr. Mushet, by reason of which he has been led into an error so far as to state in his most valuable work on iron and steel, pages 922, 923, that the materials used at the Milton Works in December 1834, with cold blast, were for each ton of iron made—

	tons.	cwt.	lb.
Coals . , ...	6	3	2
Ironstone	4	1	0
Limestone	0	13	0

At the same works in December 1836, with hot blast—

	tons.	cwt.	qrs.	lb,
Coals per ton of iron in the furnace .	2	4	3	14
Ironstone	3	11	2	21
Iron Ore	0	0	1	0
Limestone	0	16	0	14

It is. however, well known, that on an average of the year through, previous to April, 1829, when cold blast was used at the Milton Works, the materials consumed were—

	tons.	cwt.	qrs.	lb.	
Coals in the furnace . .	4	18	0	0	per ton of Iron made.
Ironstone do. . .	3	14	3	9	
Limestone do. . .	0	14	3	23	

And in comparing this with the make by hot air, in December 1836, (one of the best months in the year for iron making,) an addition of 8 cwt. of coal being made for heating the air, the difference is truly so small as to be altogether unworthy of consideration, on taking into account the deteriorated value of the produce.

[2] March 1842.

	per ton.		
Price of Scotch hot blast iron at Hull, (No. 1,)	£3	7	6
To which add for its general inferiority to Yorkshire iron	0	5	0
	3	12	6
Price of Yorkshire cold blast iron at Hull, (No. 1.)	5	5	0
Difference in favour of cold blast iron generally	1	12	6

[3] In Mr. Fairbairn's recent experiments, published in the Manchester Memoirs, the difference in this respect is very striking:—

Each bar being 1 in. square and 4 ft. 6 in. long between supports.

	Breaking weight.	Power to resist impact.
Oldberry cold blast iron	453lbs.	822lbs.
Oldberry hot do.	543	549
Using the same coal and ironstone,		
Elsecar cold do.	446	992
Milton hot do.	353	538
Working in the same mineral field in N. Wales,		
Ponkey cold do.	567	992
Plaskynaston hot do.	378	517

My attention was first called to the subject by observing great quantities of pig iron on the wharfs at the iron foundries and other places in this neighbourhood, very recently broken into pieces so short as to prevent the labourer piling them in cubical tiers in the usual manner, and on inquiry, I found that they were so broken by loading and reloading, and that they were made by the new process of using hot air in the furnace, greatly miscalled an improvement in the manufacture of cast iron. From these and other circumstances I thought it a duty due to the iron trade to call the attention of the public to it, and having mentioned the subject at the meeting of the British Association in Dublin, its importance was at once recognised, and a sum of money appropriated for making the needful experiments, which were carried into execution by Mr. Fairbairn, the highly intelligent and indefatigable engineer of Manchester; and I was very sorry to see in his report read at the Liverpool meeting, as well as in several conversations with me on the subject, to find that he had experienced great difficulty in ascertaining the composition of the irons experimented upon, in consequence of many of the manufacturers being unwilling to give information; added to this, it is well known that in more recent experiments, one of the strongest irons in Yorkshire has been placed in the scale of strength so much below other iron, long since known to be no stronger, both irons being made from the same coal and ironstone, a fence only parting the mineral fields of each work, that I am driven to the conclusion that the object of the experiments in question has in a great measure been defeated. There are, however, some experiments in them, which may not have been affected in their results by these circumstances, two of which I shall point out for your consideration.

The first will be that of iron from two works using the same materials.

Elsecar iron (cold blast) mean ratio of its strength	..	1000
Milton iron (hot blast) mean ratio of its strength	..	809
Elsecar iron mean ratio of power to resist impact	..	1000
Milton ditto ditto ditto	..	858

In this case, however, the difference is much greater than appears on the face of these experiments, inasmuch as the specimens of pig iron from the Milton Works were made with the addition of a portion of the red hematite iron ore from Ulverstone, for the express purpose of giving greater strength to that iron, as was invariably done many years for the purpose of making tin plate, and during the war for the casting of cannon.

The second circumstance is that where Mr. Fairbairn states that in a trial of 50 sorts of iron, of which each bar [4] of hot and cold blast iron were made of the same materials, and under the same circumstances.

Cold blast iron, with a load of 392 lb. increased the deflection in 108 days from 1·786 to 1·843 inches.

Hot blast iron ditto ditto 1·891 to 1·966 inches.

Cold blast iron with a load for 448 lb. continued to increase in deflection, and ultimately broke, after sustaining the weight 35 days.

All the hot blast iron bars broke in the act of loading them with the above weight of 448 *lb.*

Notwithstanding these and many similar facts brought out by the experiments in question, certain portions of them are constantly being quoted through the press for the purpose of proving that iron made by hot air is stronger than that produced by the use of cold air.

Contemporary with these experiments on a small scale, others of far greater importance have been going on; and we hear of hundreds of railway chairs, cast from iron made by the improved process, constantly breaking where tens only broke before,[5] of steam engines and other valuable machinery breaking in rapid succession, and in parts where, by regular work, they were never known to give way before the introduction of the improved iron—of the more respectable portion of mill-wrights being obliged to make new calculations, and a new stock of patterns, in order to lessen, as far as is in their power, the enormous losses and the great disappointment of their friends by such breakages. We hear of districts of coal masters and other prudent and humane proprietors of large establishments introducing clauses in their contracts for castings, stipulating that no hot blast iron shall be used therein; and at length the same has become common in contracts for gas and other pipes, which it has hitherto been usual to make of the most inferior quality of irons, it having been found that the sockets of some miles of piping have been broken off in one or two years after being laid down, in consequence of their having been made of hot blast iron.

There has, however, still more recently, been a series of experiments made, upon which a far greater dependence may be placed, inasmuch as the irons were all supplied in the regular way of business, without the makers knowing any such experiments were intended; and they were undertaken for the purpose of information only, to guide the founder and engineer who conducted the operations at his own establishment. The detail of these valuable trials by Mr. Todd, of Leeds, formed a paper read before this Society when last it met at Leeds; I need not therefore occupy your time with repeating them, and here, will only call your attention to a few of the results, for the purpose of more clearly explaining what I wish particularly to impress on your notice.[6]

With respect to the strength of bar iron made from hot blast pig iron, very few experiments have been made public that I am aware of; they are, however, of very great importance, because they were made with the greatest possible care, and regardless of expense, by manufacturers of the first eminence and ability for their private information. The irons were eight in number; the first set of bars were 2¼ inches in diameter, made with cold blast scraps and hot blast respectively, all by Yorkshire manufacturers. The weight required to draw them asunder by a steady direct tension was not very variable, but when all were cut round to the same depth, for the purpose of being broken with the hammer, they required about the following blows to do so:—

		Blows
Cold blast iron	.. ..	6
Scrap	.. ..	3
Hot blast	.. ..	1

The second and third set of bars you have now before you, the result of experiments on which stand thus:

		Diam. of bar. in.		Area of sec. where cut.		Blows required to break them with a 17lb. hammer.
Low Moor cold blast	..	2·66	..	3·976	..	18
Bierley cold blast	..	2·75	..	4·430	..	18
Milton hot blast	..	2·75	..	4·430	..	3

						Blows required to break them with a 20lb. hammer.
Elsecar cold blast	..	2·58	..	3·976	..	21
Milton hot blast	..	2·58	..	4·203	..	1½

Made from the same materials.

So that the proportionate resistance of hot blast wrought iron to *impact* is still less than that of cast iron. I need scarcely say, cold blast iron was ordered at probably 6*l.* per ton more than the hot blast iron might have been bought for.

I may here take leave to mention the circumstance of scrap iron being any thing now but what it was formerly, when its name and excellent quality were synonymous. In former times the importation of scraps from the con-

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[4] I take this to mean each pair of bars.

[5] In a paper recently read before the Institution of Civil Engineers, Mr. Macneill states that on the Dublin and Drogheda Railway, where chairs were used made of hot blast iron from Scotland, the breakage was very great as compared with those on the South Eastern Railway, which were made of cold blast iron, and that in his opinion the latter would be cheaper than the former at an increased price of 4*l.* per ton.

[6] They took place from August, 1840, to February, 1841.

				Breaking weight cwt.	qr.
Bierley pig iron,	No. 3,	made with cold blast	average	25	2
Elsecar do.	3,	do.	do.	24	0
Low Moor do.	3,	do.	do.	23	2
Summerlee (Scotch)	3,	hot blast	do.	17	2
Level Staffordshire	3,	do.	do.	16	0
Mixed pig iron	3,	5 parts Low Moor, 1 part Elsecar	do.	30	0
Mixed pig iron	3,	5 parts Bierley, 1 part Elsecar	do.	33	0
Mixed pig iron	3,	equal parts Bierley, Elsecar, Low Moor, Staffordshire, (Cylinder iron in the market,) and Level iron, also, Summerlee	do.	20	2

tinent of Europe took place to a very considerable extent, all of which were manufactured in this country into bars, sheets, &c.; and from the circumstance of these scraps, being all of charcoal iron, the bars, &c.. so made, could not but deserve the good name they acquired and long maintained. The flow of scraps into England has, however, long since ceased, and the exportation from this country having become a considerable trade, it follows, of course, that scrap iron now must be made from our own scraps; and when it is remembered how small a proportion of good iron to bad has for many years been made here, bars, &c. manufactured from them cannot but be of very irregular and dubious quality, hence it is that the best scrap iron cuts so poor a figure when compared with a well made iron from known good minerals.

The remarks I have made are in reference to irons of known good quality, but I am ready, and have pleasure in admitting that the use of hot air has been of very great advantage at those iron works whose produce had not a first-rate name, by enabling their proprietors to make it at a less cost, without a proportionate deterioration in quality; and there are some few works whose iron, made with cold blast, was so bad, that any change could not be but for the better. There is also at present a strong impression that iron cannot be made with anthracite coal only, but with hot air, and that iron so made is better than any other. The goodness of its quality is, however, due to the great purity of that coal. But even here we are told, in a paper read before the Polytechnic Society of Cornwall, by a gentleman of great practical skill, that iron made with such proportions of anthracite coal and coke as enabled him to use cold blast, became much weaker on his using hot air, all other circumstances being the same.

My apology in troubling you so far must be in the importance of the subject, and the daily increasing importance to society of the strength of that material by which the locomotive power is applied that so rapidly conveys a very large portion of the human race both by land and sea. When we are about to purchase a horse which is to convey ourselves and families at the moderate rate of 8 or 10 miles an hour, with what inherent caution our first object is to examine his knees, to ascertain his safety! In the steam-engine we are prevented taking this precaution, and yet in travelling three times as fast, our risk is in very much greater proportion. Now in this fast travelling it must not be forgot that in the engines which convey us there are two cylinders, and at least 280 returns of the piston, and therefore there are 280 percussions each minute of 9,240lb. pressure in the power itself, and also the tires of about 42 wheels and axles in each train, passing over a joint of the rails every 5 yards of our journey, the percussions of which are very sensibly felt, with numberless others of minor effect, by which it will be at once seen of what inestimable importance it is that all iron used for such purposes should not only be strong, but be so under percussion; for I need only remind you that it is more than probable, should any one of the numerous parts give way, by any one of the many percussions they have to sustain, that an accident of the most calamitous nature would be the result.

With this view of the subject I may probably be excused, if I so far further trespass on your patience as at least to endeavour to point out a duty which the public only can perform for itself, namely, to take especial care that the needful protection is given to that class of iron makers whose first care it is to maintain its utmost strength, regardless of the expense of doing so. And in order that it may be understood how far such protection is required, the following statement should be made known. In the year 1830 the total quantity of pig iron made in Great Britain was about 653,500 tons. In 1840 the make had increased to 1,396,400 tons; and although the stock of pig iron at the latter date was very small, the price of No. 1 had declined since the use of hot air from 8*l*. 5*s*. in 1836, to 5*l*. 5*s*. per ton in 1842 for cold blast iron; and from 7*l*. 5*s*. to 3*l*. 12*s*. 6*d*. per ton for hot blast iron, [7] although the workmen's wages throughout that period were rather higher, which item forms nearly 75 per cent. of the cost, from which circumstance it has been very fairly concluded, that the price of the best pig iron made has been brought down at least 30*s*. per ton lower than it would otherwise have been by the badness of trade generally, had not the use of hot air been introduced in its manufacture.

In addition to the observations I have already made on this subject, I may refer to the price current of the present day, and those who do so will see the price of cold blast pig iron in South Wales stand at 3*l*. 10*s*. per ton for No. 1; hot blast pig iron in the Clyde, 2*l*. 10*s*. per ton for No. 1; and, upon the whole, it seems this case may now be thus summed up, that—

	per ton.
The saving in the make of pig iron by the use of hot blast may (generally speaking) be	£0 12 6
Deteriorated value of such iron in the general market . .	1 0 0
Deteriorated value in the Yorkshire district . . .	12 6
Deteriorated value of castings made of such iron, in the simple article of railway chairs, as reported to the Institution of Civil Engineers, on the 1st day of March last, by one of their own body, of the first eminence, and of very great experience in such matters	4 0 0
Deteriorated value of wrought iron when manufactured from pig iron so made, in the market	6 0 0

Indeed, of the last-named iron, engineers and intelligent manufacturers are agreed, and the experiments I have before referred to, show that 6*l*. per ton is far too little a deterioration for bar-iron of such a quality, and particularly when we reflect how very much bar (and other) iron has now to do with the personal safety of millions of our fellow-creatures.

Barnborough Hall, near Rotherham.

SHANNON IMPROVEMENTS.

Lieut. Col. Harry D. Jones, R. E., Shannon Commissioner, and Thomas Rhodes, Esq. Principal Engineer, were at Killaloe, on the 17th and 18th October, to witness the discharge of the river over that part of the weir which has been completed, owing to the active exertions of the contractor, Mr. W. Mackenzie, who has advanced the works at this station so rapidly, that they may be said to be fast approaching completion.

The weir forms the principal feature of the improvements at this station, having for its objects to modify and regulate the great rise of the annual floods, by giving greater freedom of discharge and making a consequent reduction in their altitude, at the same time preserving a sufficient depth of water for the navigation.

The weir, when finished, will be 1100 feet in length, of which 618 feet are now completed.

All things having been prepared, the dam which excluded the water from the weir while building, was broken about half-past 3 o'clock on Tuesday afternoon, under the immediate directions of the Commissioners' engineers, Thomas Rhodes and Thomas Barton, Esqrs. The water having been let into the space above the weir, began to flow over it about 5 o'clock, and though the quantity passing over at present is small, yet the effect was grand. It is calculated that during the flooded seasons there will be little more than three feet of water flowing over it, although, in seasons previous to the improvements, the floods have risen to a height of *nine* feet, thus showing a general reduction of *six* feet in the height of the flood waters, and proving with what effect the hand of science can grapple with this mighty element.

The above operation has opened the canal from Killaloe to Cussane, which had been closed for some weeks, and the communication is now complete from Limerick to our pierhead.

No accident of even the slightest description occurred, and the whole went off to the evident satisfaction of all present; the day being fine, the number of spectators were very considerable. The Lord Bishop was present at intervals during the day, and the spectacle was heightened by the presence of many beautiful ladies, (of whom our gay little town has certainly an unusual share,) together with many of the gentry from the surrounding districts.

The town and neighbourhood possess great interest, both from its natural beauty and its commercial character. We here see the imprint of the Dublin Steam Company, whose great and liberal exertions in the cause of commerce and navigation, under the masterly guidance of C. W. Williams, Esq., aided by the scientific intelligence of their agent, Joseph Clarke, Esq., and the indefatigable attention of Captain Tully, keeps the curling volume from the steamers' tube gracefully mixing with the beautiful outline of our mountains, while she bears along the noble Shannon the produce of our lands, our trade and fortune, and connects our interests with the world.

From the bridge the scene is one of exceeding beauty, and becomes enhanced by historical recollections, for while we here meet, upon the banks of Shannon, many of Ireland's fairest daughters, we see reflected in the bosom of its waters the beautiful hills where, eight centuries ago, dwelt the bravest and best of her sons—Kinkora's Prince, Clontarf's hero, the great and virtuous, the immortal Brian!

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[7] I have been informed that No. 1 hot blast iron has been delivered in Leeds for 3*l*. 2*s*. 6*d*. per ton, the average of former years being 9*l*. 10*s*. per ton for No. 1 cold blast pig iron.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

June 21.—*(continued.)*

"*On some peculiar Changes in the Internal Structure of Iron, independent of, and subsequent to, the several processes of its manufacture.*" By Charles Hood, F.R.A.S., &c.

The singular and important changes in the structure of iron, which it is the object of this Paper to explain, are those which arise in the conversion of the quality of iron, known by the name of "red short iron," which is tough and fibrous, into the brittle and highly crystallized quality known by the name of "cold short iron." This change the author considers has never been attributed (as it ought to be) to the operation of any definite and ascertained law, but has generally, when observed, been supposed to arise from some accidental cause, and been considered as an isolated fact.

The fracture of railway axles, by which some of the most lamentable accidents have occurred, arises from this molecular change in the structure of iron, by which the axles lose a vast proportion of their strength.

The principal causes which produce this change are percussion, heat, and magnetism, and the author traces through a great number of practical cases of ordinary occurrence the joint, as well as the separate effect of these three causes; showing that the rapidity of the change is proportional to the combined action of these several causes, and that in some cases where all the three causes are in operation at the same time, the change of structure is almost instantaneous; while in other cases; where this united operation does not occur, the change is extremely slow, extending over several years before it becomes sensible. Among the examples given, and of which the causes are explained, are the conversion by means of heat, as in the case of wrought-iron furnace-bars, and other analogous cases, particularly when any vapour is present: the operation of the tilt hammer in the planishing of iron, by which both vibration and magnetism of the bar is produced, when the temperature is within a certain limit, beyond which limit the bar loses its magnetic power, and no crystallization occurs; and the instance of piston-rods and other cases, where from any accidental circumstance a peculiar jar or vibration has been given to particular parts. The effect of the continual jar or vibration upon the axles of common road carriages is a case of the opposite kind, where, notwithstanding the continual vibration, this molecular change does not take place *when the axle is insulated from the effects of magnetism.* In railway axles, however, the case is very different. The rapid rotation of the axle produces powerful magnetic action, while the friction causes much heat; and these effects, added to the constant percussion which is produced by the peculiar motion of railway wheels, causes the crystallization to be produced with extreme rapidity; the effect being probably further increased in the axles of locomotive engines by the magnetising power of the electricity generated by the effluent steam. The crystallized structure being the natural condition of iron, as well as of several other metals, the author considers that in these changes we observe a constant effort to return from the artificial to the natural and primal condition of the metal, and the conclusion arrived at is, that this crystallization is not necessarily dependent upon time for its development, but is determined by other circumstances of which the principal is undoubtedly vibration: that heat, although it assists, is not essential to it, but that magnetism, whether induced by percussion or otherwise, is an essential accompaniment of the phenomena. The paper concludes by pointing out the increased effects likely to result from the rigidity of the springs, the looseness of the brasses, and other causes which increase the vibration on the axles of railway carriages.

Several samples of broken railway axles were exhibited; some of them being cut from different parts of the same axles, showed that at the journals, where the vibration was the most intense, the crystallization was increased to a great extent beyond what occurred in other parts of the same axle.

Remarks.—Mr. Moreland had frequently noticed that pins for chains, and pump-rods, although made of the best iron, would, if subjected to concussion, after a certain time break suddenly, and that the fracture would exhibit a large crystallized texture. This was also frequently observed in the broken axles of road-carriages, although they were generally made of iron of the finest quality.

Mr. E. Woods had observed the crystallized fracture in all the broken axles on railways which he had seen.

Mr. Hood exhibited some specimens of broken axles, all of which showed a large crystallized fracture: he believed that the iron from which the majority of them had been made was of the best quality, and in the parts not immediately subjected to concussion the fracture was quite different. One of them had been in use only three months, and had become so brittle that, on attempting to break it, it jarred off at the shoulder of the journal, although an incision was made all round at the spot where it was intended to be broken.

Mr. York would account for the tendency of the axles to break at the journal, by that part being subjected during the process of forging to more hammering than the body.

Mr. Hood agreed that such might be the case, but he conceived that it was more probably produced by cold hammering. He had taken a sample from the body of a broken cranked axle, from the Grand Junction Railway, the iron of which was evidently of the best quality, but at the point of fracture, which was certainly at that part where it had been most hammered, the fracture presented a large crystallized texture.

A large anchor, which had been in store for more than a century, at Woolwich Dock-yard, and was supposed to be made of extremely good iron, had been recently tested as an experiment, and had broken instantly with a comparatively small strain; the fracture presented very large crystals: in this case he believed the length of time which the anchor had remained in the same position had produced the same effects as magnetism and vibration.

Mr. Lowe stated that at the gas-works under his direction wrought-iron fire-bars, although more expensive, were generally preferred; a pan of water was kept beneath them, the steam from which would speedily cause them to become magnetic: he had frequently seen these bars, when throw down, break into three pieces with a large crystallized fracture.

Mr. Miller had frequently seen in manufactories, that when the smiths had forged parts of engine-work which from their intricate forms had required to be much hammered, the ends were jarred off while they were being worked upon. He instanced particularly the side rods of the engine for the "Lord Melville" steamer, of which, while shutting up the middle, one of the ends of each rod was jarred off, and presented large crystals in the fracture; being well assured of the good quality of the iron in the rods, he had the same ends welded on again, and although the circumstance had occurred 20 years since, they were still at work, and had not shown any symptom of weakness. It must be evident that in this case, the fracture and the crystallized appearance of the metal must have been produced by the cold hammering to which it had been subjected.

Mr. York agreed with Mr. Hood in the fact of a change taking place in the texture of the iron, but he was of opinion that it more frequently occurred during than after manipulation; he alluded more particularly to railway axles, in which he believed the injury to be done by the cold hammering or planishing after they were faggoted; he had frequently seen one end of an axle fall off while the other was being hammered: in all such cases, and those of accidental breakage, such as recently occurred on the Versailles Railway, and in other places, the fracture always presented a crystallized appearance.

He then exhibited and described a railway axle, which he stated to possess the combined advantages of rigidity and toughness, and avoiding entirely the crystallization of the iron during the process of manufacture; this he described to be effected by maintaining the axle in a hollow state during the whole operation of hammering, thereby avoiding the vibration and concussion, to which cause he attributed the crystallization of the iron in solid axles, being of opinion that the repeated blows of the hammer on a solid mass, particularly during the process of "planishing," were the chief, if not the only cause of the ductile quality of the iron being destroyed. He stated, that he had made numerous experiments for the purpose of ascertaining this fact, and in every instance when the axle was sound, the iron presented the same crystallized fracture, although the bars, previous to their being welded together, were of the most fibrous quality, but if the axle was not quite sound, and the bars not perfectly welded to the centre, then the fracture was somewhat fibrous, the axle being partially hollow and thereby avoiding the vibration to a considerable extent. This fact suggested to him the propriety of keeping the axle hollow; and the mode of manufacture he described to be by taking two dished half-cylindrical bars of iron, of the entire length of the axle, putting them together and welding them under a hammer in swages, by which means the particles are not driven asunder by the heavy blows and the axle of faggot lengthened, but are driven together and towards the centre. The axles produced by this means, he stated to be as perfectly ductile as the bars in the first instance. A further advantage, he stated to consist, in being able to make half the whole length of the axle at one heat, thereby avoiding to a considerable extent the danger of burning the iron by repeatedly heating it; the iron in the axle he described, as being a uniform cylinder in thickness, and consequently requiring a uniform heat, whereas the external bars of a faggot for a common axle were liable to be burnt, before the centre was heated to a welding state. The diameter of the hollow axle was increased from 3½ in. (the general size of a solid axle) to 4 in. in order to give a proper degree of rigidity, but without increasing the weight.

The usual proof to which solid railway axles were subjected, was by allowing a weight of 6 cwt. to fall upon them from a height of 9 ft.; with that force they were frequently broken at the second blow, and sometimes by the first—he had tried some of the hollow axles, by letting fall upon them a weight of 10 cwt. from a height of 15 ft., without breaking one of them.

Mr. Simpson expressed the obligation of the Institution to Mr. Hood, for bringing before the meeting such an interesting communication, upon a subject which it is of the utmost importance to railways, should be carefully examined. It was to be regretted, that the late period of the Session had prevented the attendance of those members whose attention had been more particularly directed to railways; but on the renewal of the subject next Session, upon the production of the report upon the projected experiments, promised by Mr. Hood, a very useful discussion might be anticipated.

June 28.—The PRESIDENT in the Chair.

"*An Account of the Bridge over the Thames, at Kingston, Surrey.*" By John Brannis Birch, Grad. Inst. C. E.

Previous to the year 1828, when the present bridge was opened to the public, the communication between the town of Kingston-upon-Thames in Surrey, and the hamlet of Hampton-wick in Middlesex, was carried on by an old and incommodious wooden bridge, which was so dilapidated that any attempt to put it into a substantial condition for the service of the public, would have been equivalent to an entire rebuilding of the structure.

The corporation of Kingston, therefore, resolved upon erecting a new bridge, on a design by Mr. Lapidge, their architect, and in the year 1825 obtained an act of Parliament, granting them the powers necessary for that purpose.

The trustees appointed under the Act applied to the Exchequer Bill Loan Commissioners for pecuniary assistance to the amount of £45,000, but the application was not entertained until the working drawings, specification, &c. had been submitted to their engineer—the late Mr. Telford, when he gave the following opinion:—"Having carefully inspected all the working drawings, I consider it only justice to Mr. Lapidge to say, that they are very complete and do credit to his judgment and assiduity; and as the blue clay has been found quite across the bed of the river, I am of opinion that with the precautions provided in the working drawings and specification, that the work is very practicable, and if well executed will prove a substantial and useful edifice." He also said, "I have gone through the detailed estimates, and compared the same with the proposal accepted by the corporation, and am satisfied that the works may be properly executed for the sum therein mentioned, viz., £31,300;" and he stated "the amount of the general estimate including the above sum—the expense of houses and ground—the flood-arches and roads of approach, &c. to be £47,457."

Upon receipt of this report, the Commissioners consented to make the required loan, but it being found that the Act limited the amount to be raised to £40,000, alterations in the structure were suggested by Mr. Lapidge, which received Mr. Telford's approval, and the works were commenced on the reduced scale.

The bridge is of Grecian architecture and consists of five elliptical arches; it is constructed chiefly of brick, with ashlar facing. The abutments are terminated by towers, and the structure is surmounted by a cornice and balustrade, with galleries projecting over the piers. The span of the centre arch is 60 ft., with a versed sine of 19 ft.; the side arches are 56 ft. and 52 ft. span, and 18 ft. 3 in. and 16 ft. 6 in. rise, respectively. The highest flood rises 6 ft. above the springing line, and the lowest summer level is about the same distance below it. The foundations are all laid upon the substratum of blue clay. The length of the bridge is 382 ft. to the extremes of the abutments, and the width between the balustrades is 25 ft. The proportion of the piers to the span of the arches is about ⅛th. The roadway is formed at an inclination of 1 in 40.

The author then describes fully the constrution of the abutments, piers, arches, and the superstructure. The work occupied about 2¾ years to the completion, the first stone having been laid on the 7th of November, 1825, and the bridge opened in form on the 17th of July, 1828.

On the completion, Mr. Telford again made a report to the Exchequer Bill Loan Commissioners in these terms:—"With Mr. Lapidge, I examined the whole of the bridge and approaches, and taking it for granted that the foundations of the piers and abutments, which are under water, and which I had no opportunity of inspecting while in progress, are according to the working drawings, all the other parts are found in a very perfect state, executed in a workman-like manner."

The bridge has in every respect answered the object for which it was intended, and it has justified the good opinion Mr. Telford originally formed of it.

During the 14 years which have elapsed since its erection, it has required none other than the most trifling repairs, and the expectations of the trustees have been realized by the tolls having paid the allotted portion of the principal, up to the present time, as well as the interest of the money borrowed for its execution, and the cost of it did not exceed the amount of the estimate.

The communication was accompanied by seven remarkably well-executed drawings, showing accurately all the details of the construction, and the paper contained all the quantities of metals in the work, together with Mr. Telford's reports upon it, with other documents of interest.

"*Description of the Harbour of Port Talbot (Glamorganshire).*" By Henry Robinson Palmer, V. P. Inst. C. E.

The harbour described in this communication is situated upon the outfall of the river Avon, on the eastern shore of Swansea Bay. The adjacent mountainous district terminates abruptly at about half a mile from the shore, in a tract of marshy land, for the most part composed of sand, with detached beds of clay and peat of various thickness, at about 10 ft. below the surface.

The river, which, at its issue from its rocky channel, had been diverted from its course by accumulations of sand, nearly at right angles with its point of discharge into the sea, would appear at some period to have had a direct channel thither. It has been the object of the author, by whom the works were designed and executed, to restore this obvious course for the land water, and by means of embankments, to convert into a dock that portion of the old channel which extends through the marshes. A new channel has also been formed from the outfall to a convenient part of the dock, with a lock 48 ft. in width for the passage of vessels.

As the works were undertaken by a few private individuals, every proper economy was enjoined; and in order to diminish the expense of excavating by manual labour, a channel of 100 ft. wide and a mile in length, Mr. John Vigurs (whose extensive tin-plate and copper works are situated in the adjoining valley) proposed that the new channel should be formed by the force of the land floods, which descend with great impetuosity. A trench of 20 ft. wide by 10 ft. deep, was therefore cut in the line of the proposed channel; and a few days after it was finished, a heavy land flood descending from the mountains rushed through it, carrying out to sea from the sides and bottom of the trench an immense quantity of the soil. Every succeding flood increased the size of the trench, and by judicious guidance of this natural excavator, the channel was formed of the requisite dimensions; and it is now generally kept clear from accumulation by the land floods, but in dry seasons by the sluices in the lock-gates. The bed of the channel is stated to form a regular inclined plane of more than a mile in length, free from a shoal or any other impediment.

The confluence of the two channels has been rendered permanent, by a pier of copper slag, with an active slope of 5 to 1. When finished, this pier will extend full half a mile in length.

The paper then describes generally the ordinary modes of construction adopted in the works, and more particularly the lock, the cill of which is 23 ft. below the level of an ordinary spring tide: the coping is 2 ft. above that level, and the gates are 25 ft. 6 in. high.

The fabric of the lock is composed of hard silicious sandstone, cemented with blue lias lime water. The ashlar work of the walls is 4 ft. in thickness, with counterforts, and the spaces between them are filled with rubble, grouted with lime and sand. The whole thickness of the walls may therefore be taken at 8 ft., excepting at their bases, where they are 10 ft. The walls rest in part upon an inverted arch, 3 ft. in thickness, and the whole mass, including the invert, rests upon a concrete of large and small rubble.

The harbour is stated to be in immediate connexion with extensive copper and tin-plate works, and also with a great extent of coal-beds bordering the valley of the Avon, and the trade is rapidly increasing, its position in the Bristol Channel being highly favourable to a foreign trade.

A plan of the harbour, with the streams and channels, and a transverse section of the lock accompanied the paper.

"*Description of the Calder Viaduct, on the Wishaw and Coltness Railway, with the Specifications, Estimates, and a series of Experiments to ascertain the Deflection of two of the Strutted Beams.*" By John Macneill, M. Inst C. E.

When first the author was called upon to carry out the extension of the Wishaw and Coltness Railway, he found that the funds for that purpose were very limited, and that it was necessary to construct the works in the cheapest manner possible. To accomplish this it was necessary to design and lay out a single line of railway, which would be sufficient to carry on the trade by H. P., but if possible, and consistently with limited funds, to construct the viaduct over the valley of the Calder (the principal work on the railway) in such a manner as to be able to widen it hereafter, and to make it suitable for locomotive power, in the event of the trade being increased, or of the railway forming a part of the great line of communication between England and the West of Scotland. Having these objects in view, and being so restricted in funds, he was obliged to lay out the works in the first instance, very differently from what he otherwise would have done, if there had been ample funds.

The valley of the Calder, which the railway had to cross, was nearly half a mile in length, and the elevation of the line over the surface of the ground, varied from 50 to 130 ft. The first intention was to construct a viaduct, 480 ft. in length, of stone arches, 60 ft. span and 12 ft. wide between the parapets; but as this mode of construction would have been the cause of much expense, when it became necessary to widen the viaduct for a double line of railway, and would also have involved an embankment of nearly 60 ft. in height, composed of clay and marl, which was considered unsafe and likely to slip, an effect which subsequent experience on other portions of the line, has since fully proved would have been the case; it was determined to extend the viaduct to about 1200 ft. in length, and to construct it of timber resting on stone piers, which allowed the means of widening and strengthening it hereafter, without stopping the trade or incurring more expense than would have been necessary in the first instance, if built to the full dimensions.

The piers and abutments are built hollow, of grey freestone from the adjoining quarry of Dalziel; the trussed wooden beams rest in metal sockets, and the springing plates are laid, for supporting the under arches of bent timbers, which are now in progress of construction, to render the viaduct capable of supporting safely the weight of locomotives and heavier trains than now pass along it by H. P. The usual load for horses is 4 wagons, each weighing 1¼ ton, and carrying 3½ tons of coal; there are frequently 3 of these trains in a single arch of the viaduct at the same time, and 30 loaded waggons weighing 120 tons exclusive of the engine and tender, have frequently been taken over; on one occasion a train consisting of 65 loaded wagons of 4 tons each, making a gross load (including the engine and tender) of 279 tons was taken over the viaduct, but the usual load is restricted to 30 tons, until the under arches are fixed.

The details of the construction of the general work are then given, and the total cost of the single width is stated to be about £15,000; this sum includes the metal castings for the future widening, and when the strengthening and widening of the whole will be completed the total cost will not exceed £25,000, which is stated to be a low price for a viaduct of 1200 ft. long, and varying from 50 to 130 ft. in height.

A description is then given of the experiments upon the deflection of a trussed beam. Two stone piers were erected 100 ft. apart, with metal caps and sockets built into them; two beams were laid and strapped together and the struts fixed, precisely as they would have been in the bridge; along each side of these beams, but quite unconnected with them, posts are driven in the ground, to which a horizontal beam was attached; six rods of deal, carefully divided into inches and tenths, were then screwed to the outside faces of the beams. The beams were, in the first instance, brought as near as possible to a horizontal line, by means of a spirit level, and the zero points on the rods made to correspond with a fixed line on the horizontal bar. When the beams were loaded, and the deflection from the original level took place, it was marked by the divisions on the index rods, which being firmly screwed to the beams rose or fell with them, and showed the quantity of deflection as marked by the line on the horizontal bar; after each load was put on the beams, it was allowed to remain an hour or two before the deflection was measured, and after the load was taken off, the deflection was again measured at an interval of some hours to ascertain the permanent set, before another load was put on. The load made use of was railway bars; they were distributed over the beams in various situations, and in various quantities, varying from 1 to 60 tons; the results of which are stated in a series of elaborate tables: and a large collection of diagrams show the situation and form of the load and the space covered at each experiment. By examining these diagrams, the situation of the load, its weight, and the deflection caused by it, will be at once seen; the results of these weights are given in the tables in feet and decimals, which will be more satisfactory than the diagrams alone would be, to those who may wish to make any calculation, or to form a practical rule upon them for their own guidance.

The appendix contains the specifications for all the artificers' work, with the dimensions of the several parts and the priced estimates;—the drawings accompanying the paper were executed by Mr. Macniell's assistant, George Ellis, Assoc. Inst. C. E.

"*Description of the mode adopted for sinking a Well, at Messrs. Truman, Hanbury, Buxton, and Co.'s Brewery.*" By Robert Davison, M. Inst. C.E.

The author commences this communication, by stating that one of the principal objects of the brewers, is to obtain a constant supply of water at a low temperature, for the purpose of cooling the worts, particularly during the summer months. The quantity of water to be obtained from the land-springs has (he says) been represented as not to be depended upon; this would probably be correct, if required, as frequently proposed, for the supply of all the wants of a city, but if a well is properly sunk, there can be no doubt of obtaining a supply of 80 to 100 gallons per minute.

With regard to the quantity of water obtainable from the chalk stratum, the author believes it to be more precarious, for while instances occur occasionally, where a considerable opening is found in the chalk and a plentiful supply is obtained; the cases it is believed are as frequent, where fissures are not met with and a failure ensues.

He then proceeds to give a narrative of the facts which occurred during the progress of an attempt to sink a cast-iron cylinder from the surface down to the chalk, a depth of about 200 ft., intending to admit the springs at the different levels, as might be considered most advisable.

The well was commenced in the middle of a landspring well 16 ft. diameter, and in order to avoid the usual inconveniences of pumping and excavating, Mr. Clark of Tottenham performed a large part of the work with the "Miser" instead of by the usual methods of well-sinking.

The landspring well was drained January 25, 1839, and the excavation of a well 11 ft. diameter was commenced; this was carried down of a clear diameter of 8 ft. 6 in. inside the brick steining, and when it had arrived at the depth of 115 ft. 3 in., the first cast-iron cylinder was lowered, and others were gradually added, shutting out the springs as they were passed, until April 3, when, at the depth of 135 ft., in a bed of yellow clay and pebbles, the water overpowered the excavators, and after trying many methods of continuing the excavation, the use of the "miser" was resorted to, when the cylinders had gone down to 144 ft. On the 11th of May the oyster bed was reached, at 163 ft. depth; and after some deliberation, it was resolved to continue sinking down to the chalk. For seven days the men were employed in "jumping" a heavy chisel bar to break through the hard rocky crust of this oyster bed; at length between the 25th and 27th of May the cylinders suddenly sunk 5 ft. 6 in.; the misering was continued until the depth of 189 ft. 10 in. was attained, and the cylinders were found to be completely fixed. A pressure of nearly 100 tons applied by powerful screws was tried without producing any effect; it was therefore determined to fill all the space between the steining and the exterior of the cylinder with concrete, although a portion of the steining was discovered to have given way; it was supposed that the cylinders would have been held up by the pressure against the steining and the earth; the pump-work was therefore fixed, and after a time the pumping commenced; on the 21st October, after no more than the usual pumping (the water generally containing sandy sediment), it was observed that the pavement round the well had given way; the machinery was stopped, and immediately there occurred a rumbling noise within the cylinders which lasted probably 4 or 5 minutes; on examination, it was found that the cylinders had sunk 4 inches, the main girders across the top were broken, and on sounding the well it was discovered that an extensive "blow" of sand had taken place, and filled the bottom of the well for nearly 28 ft.; this was cleared out by misering, and after recommencing pumping for some time, on the 14th December a separation of the cylinders about 2½ in. wide was discovered at about 73 ft. from the surface. Mr. J. Braithwaite and Mr. J. Simpson were consulted as to the best method of proceeding; the former was of opinion that there was such a subsidence behind the cylinders, as would endanger the safety of the surrounding buildings. The latter did not take so serious a view of the matter; but he suggested the sinking of an internal cylinder, if the original one could not be forced down.

After this examination, a portion of one of the cylinders was cut away at 72 ft. from the surface, where the soft part of the clay commenced, and a dome was constructed with brick and cement all round the exterior of the cylinder, with the intention of supporting the brick steining and strata above, and also to carry off the water and prevent its softening the clay and the concrete.

On the 18th of March, 1840, an internal cylinder of 2 ft. diameter was lowered, within the original cylinder, and continued sinking until it reached the chalk, into which it was driven 4 ft.; the space between the large and small cylinders was then filled in with granite paving stones from 5 ft. in depth, and then with smaller stones, broken bricks, &c. mixed with hydraulic cement, to the depth of 25 ft., thus forming an effectual barrier against any future "blow" of sand from the original bottom of the well.

After all was imagined to be secure and the pumping had recommenced, a second separation to the extent of 4 in. was discovered in the cylinder; the gap thus formed was first filled in completely with wooden wedges, and a cast-iron cap was afterwards bolted withinside. The well was then drained, and 400 holes ¼ in. diameter were drilled in the cylinder, immediately beneath the oyster bed, to admit the water from that level. It was ascertained also by experiment, that the quantity of water obtained from the 2 ft. bore in the chalk, was about 22 gallons per minute; the bore was then continued for a depth of 200 ft. making the total depth of the well and the bore from the surface, nearly 400 ft., when a supply of water was obtained of 33 gallons per minute; some of the joints of the cylinders were then picked out, to admit the water, and from all the sources combined, the quantity of water obtained, was about 81 gallons per minute, or 135 barrels per hour; that is, 55 barrels from the chalk spring and 80 barrels from the sand-spring per hour.

The cost of the well and the bore was £4444, to which must be added the expense of a 12-horse steam-engine and pumps £1351, making a total cost of £5795.

Appended to the paper is the report of Mr. James Simpson, which gives a very clear account of the state in which he found the well, and the remedies which he suggested, for the accidents which had occurred.

It is illustrated by two drawings, showing in detail a vertical section of the well, with all the pumps and machinery, and also the tools used in the excavation and the bore.

"*Description of a Self-acting Signal for Railways.*" By Charles Berwick Curtis, (of Acton,) Assoc. Inst. C. E.

The object of this invention is, that notice shall be given by a marked signal, both by day and night, to the trains on the railway, that they may proceed with safety, and to regulate their speed. The signal being worked by machinery, the policemen would not be required, as at present, to remain on one spot, but could extend their sphere of inspection; and thus, by fixing the apparatus at given intervals along the line, the passage of the trains could be arranged with such precision as to render collision less frequent.

The apparatus consists of a round signal, composed of glass, the upper third part red, and the remainder green, descending into view from a casing of three colours, such as black, green, and red, in equal divisions: upon the signal is a white plate, which projects in front of and through a slit in the casing; and in order that the signal may be used by night as well as by day, a lamp is placed immediately beneath the centre of the casing.

On the near side of the rail, at a suitable distance, and at a proper height to be cleared by the steps of the carriages, is fixed a trigger, which is attached to a horizontal shaft revolving on bearings, with a counterweight, and these are connected by suitable shafts and levers with the signal-field. When an engine passes and depresses the trigger, the signal-field is released, and falls below the casing; by this means the machinery is set in action, and in a given time (which is regulated by clock-work) gradually raises the signal-field up again, within the casing, indicating by the coincidence of the coloured compartments of the casing with those of the signal, the length of time which has elapsed since the trigger was depressed. When the signal has returned entirely into the case, the apparatus has resumed its original state ready to be again acted upon.

Several ingenious modifications of the apparatus are described; and it is stated that the signals which have been at work for a considerable period at the London and Birmingham and Great Western Railways, have fully answered

Fig. 1.

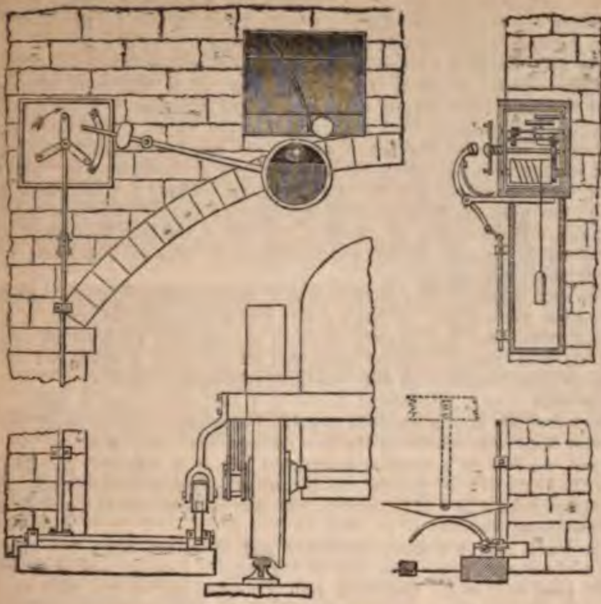


Fig. 2.

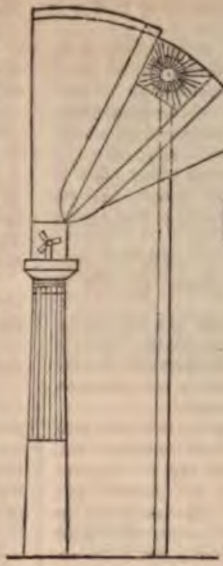
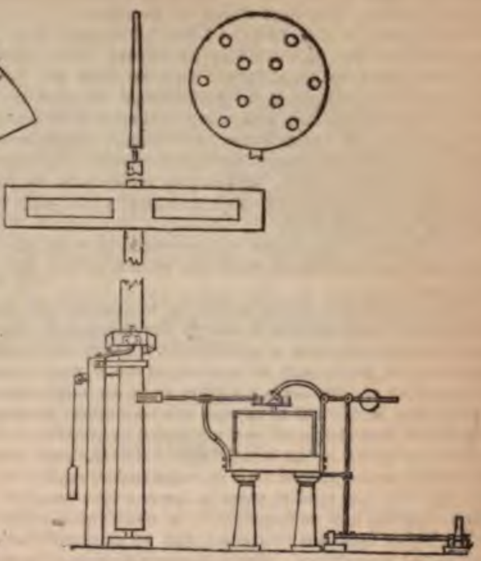


Fig. 3.



the expectations entertained of their efficacy. Detailed drawings of the signals and machinery accompany the paper.

The following description of the apparatus we have obtained from Mr. Curtis, which will more fully explain his ingenious inventions than the preceding brief minutes of the Institution.

Fig. 1, is a front view and section of the apparatus, with a round signal field descending into view from a boxing. The arrangement of the contrivance is as follows:—By the left or "near" side of the Rail, at a suitable distance, and at a proper height to be cleared by the steps, and other projections of the engines or carriages, is fixed a trigger or camb, to the end of a horizontal shaft, revolving on bearings, upon a sleeper of wood or stone, properly secured, and is furnished with a counterweight. The trigger is made to the radius of 1 ft. 6 in., of strong wrought iron, and for the purpose of securing a smooth surface, is covered with a plate of brass; at the other end of the shaft is a double joint, from which rises an upright rod, secured by guides, to the wall or framework; the upright rod terminates in an oblique link and bent neck, working in a bearing, at the point of which neck is a hammer head, which, as the trigger by the side of the rail is depressed, is forced inwards, and drawn back again by the counterweight of the horizontal shaft on which the trigger is fixed.

The signal field is fixed on a lever, having its fulcrum or bearing at about one-sixth of its length from the other end, and is sustained out of sight, that is, behind the boxing, by pins placed equidistant at three points upon a ring fixed upon the centre arbor of wheelwork, which centre arbor is immediately opposite to the hammer head of the bent neck of the upright rod, and receives its blow. The centre arbor being forced in, and thus withdrawing the pin from holding the end of the signal lever, releases it, and it falls by its own weight. The wheelwork of which the motion is sustained by a weight, and which when holding the signal lever is kept motionless, is now set in action, and the ring having the three pins revolves, and the pin next in rotation travels towards the end of the lever, consuming three minutes and a half before it comes in contact; when in contact it gradually depresses the end of the lever, and raises the signal; the white plate now leaves the red compartment, and passes on the green, and the upper limb of the field is withdrawn from view, and continues to rise with the white plate, in the green compartment, till it is wholly out of sight, and the white plate appears on the black compartment, and arrives at its resting place, whereby the wheelwork is stopped.

At night the lamp being lighted, the colours of the glass indicate the signal according to the same periods, viz.: three minutes and a half red, and six minutes and a half green light, and afterwards exhibiting the white light.

The wheelwork is so arranged that 40 trains may act upon it for one winding up. It comprises a wheel working into that attached to the barrel, the arbor of which wheel is elongated and made square, and carries the ring upon which the three equidistant pins are placed, which ring is fixed on a *boss*, made to slide backwards and forwards upon the square elongated end of the arbor, furnished at the back, or between the ring and the face of the frame of the wheelwork, with a spiral spring to drive the ring with the three pins back to its working position, when forced in by the hammer; the only other wheels necessary are those leading to the escapement, which consist of a simple balance wheel. A striker must be attached to the engines or tenders, made of ash, or other long grained wood, 4 ft. long, and 6 in. wide, cut lengthways of the grain, and inclining to the extent of one-third the length from each end towards the centre, the intermediate one-third being left straight, and so fitted that it shall depress the camb or trigger 2 in.

Fig. 2, is another apparatus, with a fan of two colours, one-third red, and two-thirds green, enlosed within a suitable boxing, having a triangular opening. The wheelwork and action are precisely the same. The train passing and acting on the trigger, the fan falls and presents its red portion in the opening, and on being drawn back its green portion, and being at the extremities furnished with glass of those colours to correspond, so as to pass before a lamp, gives the colour signals at night. The fan signal must be erected upon a pedestal, at a convenient distance from the side of the rail, and high enough to insure its being visible to the drivers of engines.

Fig. 3, is the third mode of arrangement, that of the signal mast, which is made to turn one quarter, thereby exhibiting a change of figure.

The machinery applied to this is of the same nature as the foregoing, but placed horizontal instead of vertical, and in place of a lever being released from the pins, as in *them*, a sector, with teeth working on a bearing or gudgeon into a segment attached to the mast, is employed. A weight and line is fixed to the mast, which upon one of the pins being released from its hold, as in the other arrangements, draws the mast round one quarter, exhibiting thereby the signal to indicate "stop" or "danger;" three minutes and a half are consumed in the approach of the pin to the end of the sector, and six minutes and a half from the time the pin comes in contact, till it has drawn the mast back again, and restored the signal of "safety." A lamp is fixed on a stationary standard, but is enclosed in a three-sided lantern, with coloured glass, red, green, and white lantern traversing with the mast, in front of the lamp, showing thereby the colours according to the position of the mast: red, green, or white.

One apparatus is placed at the south entrance of the Primrose Hill tunnel, and an engine fitted for the purpose of operating upon it, which it has done since the autumn of last year, and still continues to do daily with the 3 o'clock train. And on the Great Western Railway the *three distinct* forms, above described, have been erected at the Paddington Terminus.

END OF THE PROCEEDINGS OF THE SESSION, 1842.

The Institution will resume their Meetings on Tuesday, the 10th of January next.

YORKSHIRE ARCHITECTURAL SOCIETY.

First Report, read at the General Public Meeting, October 7th, 1842.

A REPORT of the past, as connected with a society which awaits its formal constitution at the present meeting, must of course be meagre; but the members have a right to know how the Yorkshire Architectural Society originated, with what support, with what field of usefulness before it, and with what prospects of success.

When several persons had already expressed a wish that in this county, which presents perhaps the best field of architectural study in the kingdom, an Architectural Society should be formed, several of the clergy of the dioceses of York and Ripon having been invited to attend, a meeting was held at Leeds, the Rev. the Vicar in the chair, on the 26th of July last. At this meeting, with the approbation of many who were absent, and with the united care of those present, provisional rules were framed, and officers *pro tempore* appointed, and it was determined that all the parochial clergy in the county should be invited to join the society in its earliest stage. That the greatest deference might be paid to authority, His Grace the Archbishop of York, and His Lordship the Bishop of Ripon were requested to extend their patronage to the proposed society, and the Lords Lieutenant of the three Ridings were requested to accept the office of Presidents. The sanction of these great names was most kindly afforded; and we were also permitted to number among our Vice-presidents the Archdeacons of most of the archdeaconries within the two dioceses, and many noblemen and gentlemen whose names must give strength to our cause. Of ordinary members we have already, and before any public meeting, more than 300 names on our list; and many of those who were among the first to give their names to the society, have expressed most strongly their opinion, evidently not newly formed, that such a society was much needed.

With regard to the objects of the society, they are stated briefly but comprehensively in the second resolution passed at the preliminary meeting, as follows:—

"That the objects of the society be to promote the study of ecclesiastical architecture, antiquities, and design, the restoration of mutilated remains, and of churches or parts of churches which may have been desecrated, within the county of York; and to improve, as far as may be within its province, the character of ecclesiastical edifices to be erected in future."

If we may be allowed to expand this resolution, we may say that whatever tends to the knowledge of the principles or details of church architecture, as it was practised in the middle ages; and whatever may suggest any improvements in the general style of ecclesiastical edifices in the present day; that whatever may tend to explode the anachronisms and other solecisms in church building now so common; that whatever may serve to extend a taste for the higher branches of the art, and to inculcate reverence for it in its most sacred applications; that whatever may indirectly encourage, or directly effect the restoration to their pristine beauty, or to their sacred use, of any ecclesiastical remains, or any part of the essential furniture of the sanctuary; whatever may come under any of these heads, the Yorkshire Architectural Society proposes to itself as the scope of its operations. How far it may be obliged to do this indirectly only by suitable publications, and by suggesting an object of study to its members, and those who may interest themselves in its proceedings, and how far directly, by rendering assistance, pecuniary or otherwise, to those who will gladly avail themselves of its aid in the repairs or construction of sacred edifices which Providence has committed to their charge, must of course depend on the resources which the society may have at its disposal, from the number of its members, or the liberality of more wealthy supporters.

That some stimulus, of some kind or other, to cultivate a better style of church building, and some direction of the public taste in matters even of the minutest detail, and most trifling repairs, is needed, must be clear to every one who will take the trouble to run over the churches, ancient or modern, within a drive of his home.

With regard to new churches, there is scarcely a populous district in the kingdom which does not possess one of the churches built in pursuance of the "Million act," as it is called; a huge cumbrous erection, Gothic in its details, without any principle, or if following any principle at all, probably Grecian in its proportions; in size beyond the compass of most voices, and in arrangement destructive of all articulate sound. The floor is divided between pews and benches, making an invidious distinction between Christ's poor, and the world's rich, and galleries destroy whatever there would have been of ecclesiastical effect. The consequence of this complication of disorders is a church empty, in proportion to its size at least, and therefore cold and comfortless to the worshippers; whereas the same sum would have built two, or perhaps three churches, not so vast, but far more beautiful, accommodating a much larger aggregate of worshippers, and forming each a centre, far more satisfactory, for the exertion of a larger number of pastors. And this there can be no doubt would have been the happier result, had the public mind been imbued, by whatever means, with those principles of ecclesiastical taste and feeling in such matters, which it is the object of such societies as this to inculcate; had those who gave their best energies to the perfecting of so good a work, been prepared to think with good taste, good feeling, good judgment, and what is inseparable from these, real utility upon the subject.

In speaking of new churches, we have chosen those which were in every sense a public work, and the responsibility of which was so greatly divided between the several parties concerned in their erection and arrangement, that they are open, with as little invidiousness as possible, to free criticism, and that it would be impossible to lay blame any where, if blame is due, but on the deficiency of the public taste at the time, for which no individuals can be accountable. But though some of the very best churches lately built have been erected under the auspices of individuals, yet to whatever class of churches we turn we still find excellence, and even propriety, the exception; and are the more confirmed in the conviction that a little greater cultivation of ecclesiastical taste would tend to the erection of far more beautiful churches, without any addition of expense, and sometimes even at a material saving.

In the repairs of churches, to which we would next direct the attention of the Society, the same thing is equally true; as we shall abundantly prove by an enumeration of some of the more common errors into which the repairers of churches are continually falling. We will again refer to actual instances though without mentioning names.

In a district of this county, the churches of which amply repay attention, there are two towns about ten miles apart, to which and to the several villages between which we will make an imaginary tour of observation.

The first church is a magnificent cross church, with a lofty spire, supported by flying buttresses, and must have been, when in its best state, among the most beautiful ecclesiastical structures in the kingdom. At present, the lower part of the great east window is blocked up by the painted canvas containing the creed, the Lord's prayer, and the ten commandments; the west window being equally spoiled by a gallery erected before it. The font, a very fine one, is not used for Holy Baptism, but only as a receptacle for a fair yellow wash-hand bason, which has usurped its use; the pewing is very irregular, and destructive of all effect; yet this is the least barbarised of all the churches we are visiting, and is indeed far less so than most others throughout the kingdom.

The next church is very small, and most unpretending, though containing some good monuments. It has a pretty screen between the nave and the chancel, which was very graceful in effect so long as it retained its original hue, but it is spoiled by white paint, and all its effect is destroyed by the emulous vicinity of the tall open panelling of a squire's pew.

The next church consists of a nave and two aisles, with a spire. The wooden roof has been lowered to so painful an excess, that the upper part of the east window is cut off by the new ceiling; the same window has also suffered the loss of a whole compartment, which is wantonly blocked up. Over the south door of the chancel is a stone with an inscription offensively commemorating a lord of the manor, who was probably art and part in some of these *improvements*.

The fourth church consists of a nave and clerestory, aisles and chancel, with a tower and spire. The roof of the nave is lowered, but it is still a pretty good oak roof. The tower arch is blocked up, and a gallery extends across it. The seats are arranged in the most originally fantastic manner possible, bending towards each other, like two marks of parenthesis, extending along the opposite sides of the nave. The font has lately served the purpose of a plasterer's bucket.

A little chapel, once very pretty, next occurs, but its effect is quite destroyed, both internally and externally, by a low square brick tower erected upon it, three sides of which have no other support than wooden props and beams. Perhaps by this time it has fallen, for the beams were very visibly and even alarmingly declining two years ago. If the tower has fallen without further damage, and has been replaced by a bell gable, which would cost a third part as much, the chapel is again a pretty ecclesiastical looking object.

Sixth and last, is the most beautiful edifice of all, a cross church, with a central tower, and splendid in all its parts, except where it has been barbarized at considerable expense by late improvers. The altar screen is of Grecian design. The roofs are lowered throughout the whole church, and those of the nave and south transepts are plastered. The west window is utterly spoiled, the nave is cut off from the transepts by galleries. The beautiful font is furnished, as almost all fonts are in these days, with a small basin for the water at Holy Baptism. The repairs on the exterior would have demanded so considerable an outlay, had they been really and wholly in keeping, that they could hardly be mentioned among things that would require only greater knowledge to have rendered them appropriate, but still they might have been less dissightly, to say the least, than they are, at the same cost.

In all these cases, such trifling matters as the glazing of windows and the like have been omitted, not as unimportant, but because they would have recurred so often as to be tedious.

It is not necessary to prove our point to give the names of the several churches we have visited, for every neighbourhood will furnish parallel cases, as each member of the Society may prove for himself on inspection.

Now, what we said of the "Million Churches," and of the divided responsibility of all persons concerned in the fabric, we repeat of such repairs. Had there been Architectural Societies in existence, or had the ecclesiastical taste been cultivated in any adequate degree, these things would have been different. More money would have been expended in fact, because devotional feeling would have been more stimulated in that direction; but this we will not assume: we will only assert that the same money would have been expended to very much better purpose.

To undo gradually and ultimately such evils as are here mentioned, and at the very least to prevent their so frequent repetition, is among the objects of this society, as well as to improve the character of churches newly erected. The field of usefulness (for surely such an object will be admitted to be useful) is co-extensive with the county, and every Yorkshireman will feel that it ought to be fairly cultivated. The means of effecting any good results may seem more limited, but the difficulty will vanish before a little consideration.

The first tangible operation of the society will probably be to obtain accurate information concerning the character and state of the churches of Yorkshire, and to collect and record whatever there may be curious and instructive in their architectural details; forming at the same time, as we may be able, a collection of casts and drawings, not from Yorkshire exclusively, but from any interesting source which may be open to us. Such a collection may seem only a museum of curious fragments, and the more extended publications of the Society mere barren records of what was once effected; and yet, even if the funds of the Society should not be adequate to any direct exertions, much will be effected by this means.

For the study of ecclesiastical architecture cannot be pursued without originating and fostering a degree of interest and enthusiasm which must be influential on the many, although it be called into active exertion only in a few. The very collection of information, with the examination of churches requisite to that end, will enlist many on the side of propriety and good taste, and there are many cases in which these appeal so intelligibly to common sense, and even to mere utility, that they have only to be fairly stated to be acted on. Every member, too, of this society will feel himself pledged, by the very fact of his membership, to exert himself in the furtherance of its objects; and at least when he has any voice and influence in the erection or repairs of a church, (and very few indeed of the clergy, at any rate, are wholly without such occasions of influence,) he will feel bound even at a little self-sacrifice, to care effectually for the appropriate character of the House of God. Nor ought we to refrain from the praise which is due in general to churchwardens and others who may be charged with the maintenance of the church's fabric. In rural districts they are generally chosen from among those whose very different pursuits leave them little opportunity for a personal acquaintance with ecclesiastical architecture and design; but good feeling they have to a great extent, and good sense; and when they find one, as for instance, the clergyman or squire of the parish, to direct them, they will seldom be found opposed to those measures which are really the best.

But we may surely anticipate the time when the funds at our disposal shall enable us to do something, as a society, in the way of restoration; and something, also, towards raising the architectural character of churches still to be erected. There are churches and chapels in this county diverted from their holy purposes, which we should wish, and which perhaps we may eventually be able, to rescue from secular and degrading uses. There are beautiful structures, with enough of them left to show what they once were, which we may hope gradually and one by one to restore. There are churches worthy of being imitated, which we may hold forth to the admiration of church builders, and the adoption of the plans of which we may procure by a seasonable addition to the building fund.

Meanwhile the members who may be really disposed to enter into what may be called the business of the society, will find it one of great interest, and will be amply repaid for their contributions to the society's museum and stock of knowledge, by the pleasure which the pursuit has afforded. The value of an object of interest in our rambles is proverbial, and hence a great part of the pleasure of the botanist, the mineralogist, and the painter. The student of ecclesiastical architecture is not less abundantly stored with interesting objects wherever he goes. With an interest attached to that particular object, and none other, every one, though but a wayfarer, with a few minutes' leisure, turns at once to the village church; but the members of our society will go thither with far greater assurance of pleasure and instruction, and stones will be vocal to him that are dumb to others. Every church has a history which may be read in its walls, its buttresses, its doors, its windows, its mouldings, its font, its roof, its seats, its chancel, its altar; a history with his eras, its incidents, and its episodes marked in broad lines, and in traces deep and vivid of the chisel of the mason and the sculptor, and of the brush of the plasterer and painter; in the restorations and additions of medieval architects, and in the perversions and monstrosities of modern carpenters and masons. The history is one of interest and of value, and one which he can transcribe and bring away for the amusement and instruction of others, and not without a hope that he is acquiring and conveying information which will be practically applied in many future instances.

But let us attempt to convey some impression of the interest of the pursuit which we are entering upon, by a particular instance. Three years ago, two persons, now enrolled among the original members of the society, were walking on the banks of the river Ure, near Ripon, when their attention was arrested by what seemed in the distance a neglected ruin, but of what character, whether a church, a house, or a barn it would be difficult to say. However, they bent their steps towards it, and first approaching a cluster of alms-houses, found the supposed ruin to be a little chapel, sadly neglected, and almost desecrated, by the near approach of houses, farm yards, pig sties, and every kind of rubbish. The exterior, besides being extremely picturesque, chiefly from the effect of a tall bell-gable, afforded indications of great antiquity, and of very considerable changes; and in short, bore upon its face the history of six hundred years. The door-way had been Norman, the East window was of three or four hundred years later date, and there were traces of intermediate alterations; while the present dilapidated state of the whole edifice, gave in sad colours the story of the last two or three centuries. Within, the little unpretending chapel was full of still deeper interest. The wooden roof, the original open seats, and the screen remained, though craving many repairs. Altar rails there were none, and never had been; before the altar was a little circle of mosaic, and the altar itself was such as was not then generally known to exist in the whole kingdom—it was the old stone altar, which had escaped the hands of sacrilege and destruction. Now this was, all will admit, an interesting discovery, and it was certainly more than will fall to the lot of every one every day; but it is so far from being unexampled, that day after day other stone altars are being discovered, and other churches and chapels which have been hitherto as little noticed as that of St. Mary Magdalene, Ripon, are found to contain the most interesting remains, and details well worth the study of the student of practical ecclesiastical design.

Enough, perhaps more than enough, has been said, to conciliate your favour to this society, and to stimulate your interest in its pursuits. Here therefore, we should conclude; but it is perhaps as necessary to disarm suspicion, by stating the limits of this society's operations in one direction, as to say what we may well hope it really will effect. It will not, then, interfere with the strictly professional labours of the architect, nor in any respect supersede the application of his skill and science. On the contrary, it will afford him a very great support, unless we over estimate its influence on the public mind, against the injudicious suggestions and the very irritating interference of those who cannot be supposed really to understand the subject yet who stand greatly in the way of any degree of excellence in the works committed to their oversight. Those architects who really understand the principles of Gothic architecture and of ecclesiastical design, and who only want room and liberty, and a just appreciation of their talents to distinguish themselves, will, we are persuaded, find in the Yorkshire Architectural Society a very effective ally.

Having thus stated the object of the society, we may, we trust, leave it to the favour of the public, and at once, with the confidence of all parties, enter upon its pleasing and useful sphere of duties.

REVIEWS.

Appendix E, F to the new edition of Tredgold on the Steam Engine. Engines of the Trent and Isis, Dee and Solway, &c. Twenty-one Illustrations. London: John Weale, 1842.

The chief fault we have to find with this work is that there is too little of it. Brevity, indeed, is a quality of which we rarely have to complain, yet in the case of such machinery as that of the *Trent* and *Isis*, we should rather have had all the details, though the work had been a little dearer and more voluminous in consequence. It forms no part of our function to inquire whether it is upon the publisher of the work or the makers of the engines, that the absence of these details is chargeable; but the policy which has withheld them, wherever it may have originated, is, we are satisfied, a blind and injudicious one, and is impotent for everything but mischief. The only drawings of these engines which are given, are a plan, elevation, and end view; and these, we suppose, are to prove their title to the public admiration:—as if any one could tell whether an engine were good or bad by merely looking at the outside of it. We are, it is true, provided with the performance of the engines as determined by the indicator; but every one knows that an indicator diagram furnishes no criterion of the quality of an engine as a piece of mechanism, and that an engine may give an admirable diagram, and yet be a bad engine in many respects. The true character of an engine is, it appears to us, only to be determined either by an examination of the details of its construction, or by the experience afforded by its prolonged operation. The latter test is certainly a very satisfactory one, but requires a lifetime for its application, and is, we fear, too tedious and transcendental to arrest very forcibly the public attention, or enable a man to make his way among a crowd of tumultuous competitors. Those who plume themselves upon mysteries unknown to the commonalty, and imagine that the public confidence is to be won by lofty and unsupported pretension, will be laughed at and disregarded, and we think that Messrs. Miller, by withholding from the public eye the details of their engines, have defrauded themselves of the glory to which they were justly entitled, and rendered vain the superiority which those details would have made manifest. However sensible we may be of the excellence of Messrs. Miller's machinery, we are as sensible that any praise of ours is open to the charge of partiality which is based upon evidence inaccessible to the public; and we are heartily provoked at a policy which renders our commendation fruitless, and casts a veil over such high and varied excellence.

It may, indeed, be the case, that the denial of these details to the public is only a peace offering to that passion for secrecy which has become epidemic among engineers, and which we look upon as one of the most humiliating events in the history of that great fraternity. But this is surely a very pusillanimous motive, and even on the score of expediency affords, we think, but a poor palliation. The sober part of the community very well know that any attempt at secrecy in engine making is preposterous, and that it is impossible to prevent people from becoming acquainted with the structure of engines which are scattered all over the world, and to which any one may obtain such easy access. Engravings of the best engines of Messrs. Maudslays and Messrs. Miller, in which all the details of construction are represented, are current enough on the Continent, and the French are at this moment constructing engines from accurate drawings of those of the Great Western. The engines of one maker are frequently put into the hands of another for repair; draughtsmen and mechanics migrate from one factory to another, carrying with them all its mysteries, and every one knows that any particulars of any practice may be obtained without considerable trouble. Yet in the face of all this, each engineer imagines that he possesses certain mighty secrets which are hid from all the world beside, believes that the publication of a few very well known expedients would ruin him entirely, and mistakes the rejection by other engineers of the plans he has chosen to adopt, for a happy ignorance of their existence. Opinions, however, such as these, are only to be laughed at, but a different demeanour is due to those who not only refuse to give any practical information on the subject of the steam engine themselves, but throw every impediment in the way of those who are disposed to be more communicative. The appearance of Mr. Farey's admirable treatise on the steam engine was gall and wormwood to these high-minded gentry, because, indeed, "they feared it would make every body else as wise as themselves," and the publication of some of the dimensions of marine engines in a late number of this Journal raised a din and consternation which we could not have conceived possible from a cause so inadequate. For this and other aids to engineering we have been held up as enemies to engineers, and have been charged with the infliction of injury upon individual practitioners, by opening the door to the crowd of uninitiated. But upon what authority was the door ever closed, or when did it become insupportable injustice to hinder men from being unjust to their neighbours? There is but little of the knowledge which contemporaneous engineers possess, which they have not derived from their immediate predecessors, and in attempting to exclude the rising generation from the benefit of this common stock, they have arrogated to themselves a right they never could have possessed. Toleration for their personal prejudices and private aberrations we are willing to accord in the largest measure; but who ever heard of toleration for intolerance? Who ever heard a man cry out because he might not insult and tantalize his fellow creature, choke up his path with thorns, and shut him out from benefits to which he is equally entitled? Every one but the members of this party can see the folly and injustice of such courses, and those who have the interests of those persons most at heart, will be the most solicitous to wean them from them.

The first article of the letterpress which accompanies the plates is an account of the hulls of the *Trent* and *Isis*, which contains some acceptable information. The next article is a short account of the *Orion* steamer, and then follows a description of the engines of the *Isis*, which betrays, we fear, a little superficiality, yet contains much strong sense, and only a moderate infusion of error. After this comes the specification of the hull of the Cyclops, and lastly an account of the engines of the *Dee* and *Solway*. The few remarks we intend to indulge in we shall devote principally to the machinery of the *Trent* and *Isis*, by Messrs. Miller & Ravenhill, and that of the *Dee* and *Solway*, by Messrs. Scott & Sinclair, of Greenock.

The most conspicuous peculiarity of the engines of the *Trent* and *Isis* is the absence of all pretention to architectural beauty. The frames of the *Dee* and *Solway* are of the Gothic order, the crank shaft being supported by Gothic columns. In the *Trent* and *Isis* on the contrary, the crank shaft is sustained by unadorned plates of metal, with large feathers cast on their sides to stiffen them laterally, so that the section of each support somewhat resembles the figure of a double cross. The purpose of this practice is to distribute the metal properly in every part of the frame. In the case of columns, it is contended, the core may float in the process of casting, and make the column thicker on the one side than on the other—a defect to which the crucial system is not liable, but the existence of such a defect at all, involves the supposition of excessive negligence on the part of the moulder, and is altogether so remote and unusual as to be only susceptible of measurement by an infinitesimal mensuration. If pipes can be cast without any injurious inequality when the thickness does not exceed half an inch altogether, it is difficult to see how the injury can be very serious when the thickness is increased to 3 or 4 inches, and the proportion of any inequality diminished correspondingly.

The author of the description of these engines ascribes great importance to the horizontal crosses introduced in the *Trent* and *Isis* between the crank and intermediate frames of each engine, but we dissent from his judgment in this particular, and attach far more importance to a horizontal cross between the engines. He wastes much rhetoric in showing that the shock of the paddles and the racking which ensues when the engine is reversed constitute strains which it is hard for the framing to resist. But the formidable character of these strains is as regards the framing purely imaginary, and the whole of this part of the description, though indicating considerable talents, is overcharged, hypothetical, and preposterous.

The diameter of the cylinder of the *Isis* is 74¼ in., the length of the stroke 7 ft., and the number of strokes per minute 11½; the mean vacuum in the cylinder 12·705lb.; the mean steam pressure 2·235lb., which deducting 1·25 for friction, leaves the effective pressure on the piston 13·69 lb. per square inch. The indicator diagram shows the steam to be cut off at between two-thirds and-three fourths of the stroke. The quantity of lap proper to this degree of expansion may be computed by a formula we gave in a former number.

The Isis was, we understand, a very heavy vessel, sank deep in the water, and was in consequence never very rapid. The author of the description before us, suggests, that inasmuch as there would appear to be an objection against working large engines at a high speed, it might be expedient to employ small engines in steam vessels, and work them at such a speed as to produce a power equal to that of the larger engines working slowly. But there is nothing to prevent large engines from being worked at a high speed so far as the engines themselves are concerned; and the speed of the engines of the Isis might easily have been doubled without difficulty or detriment. But if the engines of a steam vessel be worked at such a speed as to involve the rotation of the padde wheel with undue rapidity, a large proportion of the engine power will be wasted in throwing the water back from the wheel instead of being spent in forcing forward the vessel. In short, a certain relation must always subsist between the velocity of the wheels' rotation, and that of the vessel's progress; and this must of course fix the velocity of piston which in a vessel of ordinary construction will produce a maximum effect. Small engines driven at a high velocity might answer very well if the paddles were on the second motion, as it is technically phrased; in other words, if they were so arranged that the engines might run at a high velocity without affecting the relative speeds of the paddles and ship; but with the present modes of arrangement, small engines would not answer at all: and we do not see how it is possible to apply them under any sort of arrangement, without resorting to cog wheels, which in steam vessels are, it is agreed, objectionable.

We have never been any great admirers of the engines of Messrs. Scott and Sinclair, yet in many points we admire the engines of the *Dee* and *Solway*. They are greatly superior to anything we have hitherto seen from the same factory, and are we think a favourable specimen of engines of Clyde manufacture. There remains, it is true, even yet a good deal too much of the old leaven; the joints, for example, are still made of rust, instead of being metal to metal, as in the London engines; the air pump rods are cased, and the iron is exposed to the corrosion of the salt water at the lower ends, instead of which they ought to be of solid copper or Muntz's metal; the valve casings are without expansion joints, the effect of which must be to keep the joints on the level of the cylinder cover in a state of eternal leakage; the piston packing consists of three tiers of rings, and is of an antique and complicated description, long exploded in civilized communities; the upper and under portions of the D valves are connected by two rods instead of three, and the holding down bolts are of the most perishable description; yet in spite of these defects, the engines are upon the whole of excellent quality, and contain, perhaps, more excellences and fewer imperfections than are to be found in the works of some makers of more exalted pretentions. The framing, we look upon as being the handsomest, and among the best of any hitherto constructed; the side levers and many of the other working parts are well proportioned, and there is manifestly no niggardliness either in workmanship or materials. Whatever faults may still adhere to machinery of this firm, they are not, we conceive, attributable to penury of skill, or insensibility to excellence, but arise, we think, from the difficulty of changing completely and suddenly a vicious system. Most of the grosser vices have already been exterpated, and the whole may be got rid of in a few years time, even at the same rate of progression.

We have, we fear, drawn out these remarks to a greater length than our readers will thank us for, and have only room to observe in reference to the drawings of hulls of vessels here given, that they are excellent. This part of the work contains a large fund of valuable information, and will, we are sure, be appreciated by a wide circle of readers. The whole of the plates are admirably engraved, and the typography which accompanies them is of the very first quality; nothing, indeed, can surpass the skill and liberality which shine out in the mechanical department of all the works issued by this publisher; and the height of this very excellence makes us the more regret that the intellectual department is so rarely of a correspondent quality.

Blunt's Civil Engineer and Practical Machinist. By Charles John Blunt, C. E., &c. London: Ackerman and Co.

To describe the contents of this work is the best way to show its value. They consist of six copper-plate engravings the size of imperial, taken from the working drawings from which the machines were actually made, which renders them authentic records of the machinery of some of our first engineers. We could have wished, however, to have seen a little more finish to some of the plates, and the dimensions more generally given; for instance, we will allude to the engraving of the Thames Tunnel, in which the inverts appear to abut upon nothing in the centre, and the brickwork of the shaft ought to have been shaded or hatched.

The first plate contains the drawings of a marine dredging and excavating engine, and deepening machine, employed in the formation of harbours, constructed by Messrs. Rennie, being the engine erected for the harbour of Barcelona; the plate is 42 in. long, and 18 in. broad; many of the details are delineated upon an enlarged scale. Mr. Blunt, contends, that the late John Rennie was the original inventor of the dredging machine, but does not state the year he first introduced it at the Hull Docks. This statement is at direct variance with an article that appeared in the *Journal* for January 1839, page 9, vol. 11, by Mr. Thomas Hughes, wherein he claims the invention as that of his father, who used the dredging machine off Woolwich, in 1804. Now the question is, did Mr. Rennie introduce the machine prior or subsequently to that date? Mr. Hughes says subsequently, which remains to be disproved by date. There cannot, however, be a question that the late Mr. Rennie, together with his talented sons, have brought the machine to that great perfection it has now attained.

The second and third plates represent a steam engine for driving machinery and mills by Messrs. Rennie. The fourth contains drawings of a direct action marine engine, with side guides, and the section of an iron steamer, also by Messrs. Rennie; we have here to find the same fault as we have done in another review given in the present *Journal*, for omitting to give the sections showing the interior of the engines, and likewise some details and dimensions; without them, it is useless to give mere views of the exterior. We believe this vessel and engines were tried by Messrs. Rennie during the last season, when the vessel proved to be one of the fastest steamers on the river Thames. The fifth plate is the Thames Tunnel, containing a longitudinal section, showing the archway, the shield, the driftway, and the formation and sinking of the large shaft on the Middlesex side of the river. The sixth plate is devoted to a fifteen ton crane, constructed by Messrs. Rennie.

We think we have shown enough of the work to prove its importance as a national record, and a work of value to the engineer. We trust, however, that in future more attention will paid to the engravings, and likewise to the insertion of the details, which will greatly enhance the value of the work, and make it one of reference for the profession.

The Mechanical Principles of Engineering and Architecture. By the Rev. Henry Moseley, M.A., F.R.S., Prof. of Nat. Phil. in King's College, London. London: Longman & Co., 1843.

Professor Moseley's previous works have at various times come under our notice, and we have felt it our duty to express our feelings of the spirit of research and enterprise with which the author has exerted himself for the promotion of constructive science. Placed at the head of an important department of collegiate instruction, Mr. Moseley has felt the necessity that exists for the adaptation of scientific principles to the practical pursuits of the engineer and architect, with whom the progress of new combinations and new constructions renders it imperative that the classbooks and works of reference should be frequently remoulded and made applicable to the wants of the day. It is in union with these requirements that Mr. Moseley has been induced to undertake this work, in which the application of mechanics in the varied pursuits of the engineer and architect is taken into consideration. Under the head of dynamics, Mr. Moseley has directed his attention to the subject of *duty*, for which he proposes to substitute the term *work*, in imitation of the French '*travail*;' he observes, that " the English word 'work' is the obvious translation of 'travail,' and the use of it appears to be recommended by the same considerations. The work of overcoming a pressure of one pound through a space of one foot has in this country been taken as the unit, in terms of which any other amount of work is estimated; and in France the work of overcoming a pressure of one kilogramme through a space of one metre. M. Dupin has proposed the application of the term dyname to this unit. I have gladly sheltered myself from the charge of having contributed to increase the vocabulary of scientific words by assuming the obvious term 'unit of work' to represent concisely and conveniently enough the idea which is attached to it, without translation." To the term "unit of work," we cannot see any objection.

Mr. Moseley's researches on the mathematical relation of machinery, which he terms "the modulus," are known to our readers; in the present work he has applied himself to the determination of the modulus of toothed wheels, and of bevil wheels, and he has also considered the influence of the friction of the teeth of wheels and that of their axes and weights. Upon this he observes, "an approximate form of this modulus applies to any shape of the teeth under which they may be made to work correctly; and when in this approximate form of the modulus the terms which represent the influence of the friction of the axis and the weight of the wheel are neglected, it resolves itself into a well known theorem of M. Poncelet, reproduced by M. Navier and the Rev. Dr. Whewell. In respect to wheels having epicycloidal and involute teeth, the modulus assumes a character of mathematical exactitude and precision, and at once establishes the conclusion (so often disputed) that the loss of power is greater before the teeth pass the line of centres than *at corresponding points* afterwards; that the contact should, nevertheless, in all cases take place partly before and partly after the line of centres has been passed. In the case of involute teeth, the proportion in which the arc of contact should thus be divided by the line of centres is determined by a simple formula; as also are the best dimensions of the base of the involute, with a view to the most perfect economy of power in the working of the wheels." In the third part our author has taken up a subject, but little treated upon in works of this nature, hitherto. The theory of machines, in which he considers the simple powers and their applications, the capstan, the Chinese capstan, the whimgin, the applications of the screw, the beam of the steam engine, the crank, double crank, crank guide, governor, carriage wheel, &c. The fourth part is devoted mainly to construction, and in this are carried out and applied Mr. Moseley's researches on the line of resistance as occurring in walls, foundations, buttresses, piers, &c. In the discussion of the distance of the line of resistance from the extrados of a structure, at the point where it most nearly approaches it, Mr. Moseley has called it the modulus of stability, preferring this measure of stability to the co-efficient of stability used by the French writers. In the determination of the pressure of earth upon revetment wall, and in the theory of foundations, Mr. Moseley has introduced to English students, M. Poncelet's application of Coulomb's theory. Mr. Moseley's views upon the theory of the arch, are known to the public, by his contributions to Hosking and Hann's "Treatise on Bridges;" and in the present work he has inserted the tables of the thrust of circular arches, calculated by M. Garidel, from formulæ founded on the theory of Coulomb. In considering the strength of materials, Mr. Moseley has applied a new method to the determination of the deflexion of a beam under given pressures, and under this head as incidental to the discussion of rupture by elongation, the theory of suspension bridges has been considered. Upon this he says, "This question, so complicated when reference is had to the weight of the roadway and the weights of the suspending rods, and when the suspending chains are assumed to be of uniform thickness, becomes comparatively easy when the section of the chain is assumed so as to vary its dimensions as to be everywhere of the same strength. A suspension bridge thus constructed is obviously that which, being of a given strength, can be constructed with the least quantity of materials; or, which is of the greatest strength having a given quantity of materials used in its construction." A new class of problems has also been introduced by the author, having reference to the forms of girders connected by slender ribs or by open framework. The subject of the strength of breastsummers has also been extensively investigated. There are several tables dispersed throughout the work and in the appendix which are of great use both to the engineer and architect. We are much gratified with this work indeed; the more so, as the author has availed himself successfully of the labours of the French mathematicians, whose superiority is not merely unrivalled, but almost unknown in England. The best, therefore, that we can do at present, is to profit by their exertions, with the hope that when once we enter into the field, we may, as in other cases, ultimately take the lead where our neighbours have shown the way. The work of Professor Moseley may indeed be considered as an earnest of what may be done in "applied mechanics," hitherto so much neglected by us, although of such essential importance. This is a good beginning, but we hope to see the subject carried out in practical examples, so as to be within the reach of the working man.

The Cornish, and Boulton and Watt Engines, erected at the East London Water Works, Old Ford. THOMAS WICKSTEED, Engineer. London: John Weale, 1842.

Mr. Wicksteed has been unceasing for the last five years, in bringing forward the merits and the superiority of the Cornish engine, for pumping; he has manfully fought through all the prejudices that were raised up against it. Before the Institution of Civil Engineers, has he night after night contended, almost single handed, with his opponents; in the engine room has he daily watched the progress of the construction of the engine, and hourly has he experimented upon every part of the ponderous machine, to trace the cause of the superiority of the Cornish engine for pumping, over that of the ordinary engine; all his experiments he has recorded publicly, in such a plain, candid and unostentatious manner, that it has called forth the praise of all; these were published some time since, and reviewed by us in the *Journal*, p. 398, vol. 4. Now, he has given us the engine itself, so accurately set forth in plan, section, elevation, detail and dimensions, without attempting to conceal any portion, so that any engineer may set to work and construct an engine from the drawings he has favoured us with. Besides the Cornish engine, Mr. Wicksteed has also furnished us with drawings and description of the Boulton and Watt Pumping Engine and Boiler, upon which he also made the experiments before alluded to. The plates are elaborately engraved by Gladwin, of the size of imperial, and are accompanied with a very clear description, drawn up by Mr. Graham, the Secretary of the Society of Arts. There are four plates of the Cornish engine and boilers, and four plates of the Boulton and Watt engine and boilers, which likewise exhibit Stanley's Feeding Apparatus; and with the letter-press there is an engraving by Lowry, of Messrs. Harvey and West's Patent Pump Valve, similar to the one with description that was inserted in the *Journal* for February 1840, vol. 3, p. 41. These valves ought to be adopted for all large pumping engines.

We are sure it is unnecessary for us to recommend such a very valuable work to the profession, for we feel certain it will soon be in the hands of every one who takes a lively interest in the steam engine.

Companion to the Almanac for 1843.

OF this new volume of the "Companion" we shall say very little at present, it being our intention to notice the architectural subjects it contains next month, when we shall be able to speak of them more fully than we can now do off-hand, just as our number is going to press. In the interim we merely mention some of the articles in the bill of fare, viz. Messrs. Wyatt & Brandon's new church at Wilton, and their Assize Courts at Cambridge; Mr. Poynter's church, Broadway, Westminster; the Wesleyan College or Institution, Richmond; and Mr. Ewart's offices, Liverpool; which last structure is not the least commendable for the taste displayed in it. Although these constitute the more prominent subjects, several other buildings are noticed, and some of them are rather fully described—for instance, the houses composing the façade and building in front of Marks' Carriage Repository, Langham Place, or rather what is the principal one of that group of houses, and which, though it does not show itself externally to be larger than the rest, is internally equal to three of them. This residence is laid out in very superior style, and has a library or gallery very striking in its plan and effect.

There can be no doubt that the "Companion" has contributed not a little to render the subject of architecture more popular than it used to be, as it is a very widely diffused publication; nevertheless, that portion of the work is susceptible of improvement, for a greater number of pages might be allowed for it.

Philosophical Conversations. By FREDERIC C. BAKEWELL. London: Harvey and Darton.

This is the second edition of a cheap and popular work on the application of natural philosophy to the pursuits of daily life, and is an explanation of the most striking terrestial phenomena, and which we strongly recommend to the young friends of our readers.

Ancient and Modern Architecture. Edited by M. JULES GAILHABAUD. Part 2. London: Didot & Co.

The present number is of more interest even than its predecessor. It introduces to the architect the Persian monument of Nakshi Rustam, a most curious specimen of that ancient school of art. The accompanying plates illustrate the well known cave temple of Ellora, in the East Indies.

Record of Patent Inventions. By ALEXANDER PRINCE.

A valuable addition to this class of periodicals. It takes upon itself as its distinguishing characteristic, the duty of giving *all* specifications as they are enrolled, which appears to be done with great clearness.

Adcock's Engineer's Pocket Book for 1843. London: Simpkin and Marshall.

This contains the usual mass of valuable tables and useful information for the engineer.

English Patents. By ANDREW PRITCHARD. London: Whittaker and Co.

This is a useful list of patents for 1841, with an index.

PROF. DONALDSON'S LECTURES ON ARCHITECTURE.

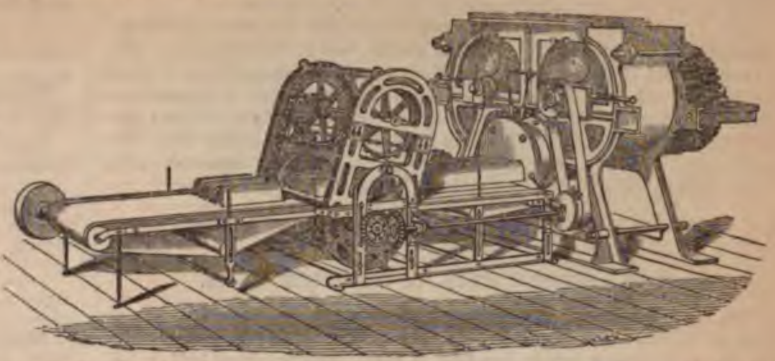
We have on several occasions attended Mr. Donaldson's courses at University College, and are pleased to see the success that attends him in the discharge of his duties, and in the number of his pupils. The courses at present are purely elementary, and are well illustrated with drawings and experiments. From time to time examinations of the pupils on the previous lectures take place, when the pupils answer either orally or by drawing the subject to be described. It was evident from these examinations that the class possesses the best qualifications in students—attention, and they seem also to take a great interest in the lectures. In a recent lecture on the Corinthian order, Mr. Donaldson observed, in reference to the fabulous origin of the capital, that some people were inclined to look with a severe eye on such tales. He, however, did not think that in a study so abstruse as theirs, the imaginative should be quite discarded. He thought that they ought to be allowed to beguile themselves a little in the regions of imagination. Paraphrasing Cicero's saying—"Nemo unquam magnus fuit sine aliquo afflatu divino," he went on to remark that, "no man ever produced a great work without great effort of their imagination; and that if they rejected the fable on historical grounds, they could at least learn one lesson from it—always to look at nature, and they might derive from the commonest objects happy ideas which they might introduce into their own works. Even going along in his walks in the neighbourhood of the metropolis, he often saw in the rank weeds of the ditches, luxuriant foliage, well calculated for architectural effect, and took out his pencil and sketched them." He gave it as his opinion that the original Corinthian capital was to be sought in those specimens where the corniculi are deficent and where only a row or two of foliage surrounds the cap.

WHITE LEAD.

A new process of manufacturing white lead or carbonate of lead, (and for which a patent has been granted for Great Britain and Ireland,) is now being exhibited at the late "Pin Manufactory," in the Borough Road, Southwark. We have not yet had an opportunity of fully satisfying ourselves as to the white lead produced by it, and shall therefore notice it in our next number. However, as far as we can judge from examining some small samples which have been furnished us, we are of opinion that the quality is quite equal to the best made by the ordinary or old process. The rapidity, cheapness, and simplicity with which the metallic lead is converted into a carbonate by this process, is sufficient to recommend it to the investigation of those who are engaged in the manufacture of so important and indispensable an article. We are informed that a manufactory, by the process alluded to above, has been for 2 years successfully in operation in America, and that patents have been secured in most of the Continental kingdoms.

South Eastern Railway.—The Saltwood Tunnel.—This work which has hitherto assumed a very formidable aspect owing to the immense quantity of water, we are happy to state is being successfully dealt with; the stratum is the lower green sand, containing an immense volume of water; the difficulty has been in sinking the shafts and driving the adits at the level of the bottom of the tunnel, which arose from the rapid collecting of the water so as to compel the miners to retreat from the works or they would have been drowned; this has now been successfully overcome, and the adit is formed completely through the hill so as to let all the water run out at one end, where nearly 30,000 gallons of water now flow every hour; we are informed that about 30 millions of gallons of water were drawn to the surface, during the time the workmen drew 3500 yards of earth or about 30 times the weight of water compared with the earth. The tunnel is now commenced and there appears to be no real difficulty left in the way of its completion.

AINSLIE'S PATENT BRICK AND TILE MACHINE.



This Machine is now being exhibited at the "Pin Manufactory," in the Borough Road, Southwark; it is applicable for making Tiles of different sizes, and likewise Bricks of almost any shape, by simply shifting the front plate of the lower box. It is altogether different from any other machine that has hitherto come before the public. The articles made by it are of the best description, as the clay is in no way strained (as in some other machines, by turning the clay from a flat to a curve) but is in fact pressed through the moulds in an equal and regular manner, leaving the top as well as the bottom of the tiles, equally solid, substantial, and far more durable, requiring less fuel to burn them than in the ordinary mode of manufacture. One of the machines has been erected for the Marquis of Lothian, and appears from the following extract to answer the purpose.—"Amongst the machines recently introduced for the manufacture of drain-tiles, that under the patent of Mr. Ainslie, Redheugh, Mid-Lothian, stands pre-eminent, whether as regards the amount of its production, or for the quality of the article which it produces. There is a directness in the principle on which tiles and bricks are formed by this machine, that gives them at once greater solidity and soundness of texture than any process hitherto adopted. * * * Tiles of any size, from a 9 in. main-drain down to the smallest conduit, can be made by this machine, at rates varying from 14 large mains to 36 small conduit-tiles per minute, or from 8000 to 20,000 per day."—*Stephens' Book of the Farm, No. 7, p.* 581, 582.

The following description of the machine, furnished by the ingenious inventor, will explain its action and utility.

In consequence of the rollers being near to each other, little more than one quarter of an inch apart, every obstacle, such as stones and other hard substances, are crushed to powder, in their progress downward, thereby giving proprietors of clay fields the power of manufacturing their own tiles, even though the clay should be of an inferior quality.

Immediately below the centre of the rollers is placed a cylinder lying horizontally, with an opening 1½ in. wide on the top, through which the clay enters; and on each side of the opening is placed a scraper to clean the rollers and duct the clay into the lower cylinder. In the latter cylinder there is a powerful double spiral screw which revolves, the threads are about 7 in. apart, consequently whilst the rollers force the clay in a perpendicular direction through the opening into the threads of the screw, the screw forces the clay horizontally into the chamber in front of it, for holding the mass of clay into which the screw empties itself. In front of this chamber, a plate with moulds is screwed, so that when the chamber is charged, the overplus is forced through the moulds from the mass of clay in a continuous stream, on to an endless cloth, which moves the moulded clay forward to the cutting frame, consisting of two endless chains inclining a little from the perpendicular, to which, two wires are attached horizontally by hooks; these chains are moved by a belt to the shaft of the first roller of the endless web, to suit the speed of the clay, and is kept constantly revolving, so that the wires divide the clay, during the continuous movement of the new moulded tiles, which are then pushed forward by the uncut clay over small rollers, till they reach another endless web, from which they are taken.

In order to prevent breakages, a strong friction hoop is placed upon the driving shaft of the machine, which is screwed up, till it puts the machine in motion. Suppose either by accident or intention, iron or any other hard substance was thrust into the machine, this friction hoop will yield to the strain of such a substance, thereby causing the machine to stand still, till the obstacle is removed. When the clay is very irregular, a pug mill is recommended to feed the machine.

GILLOT'S PATENT FOR HEATING AND VENTILATING.

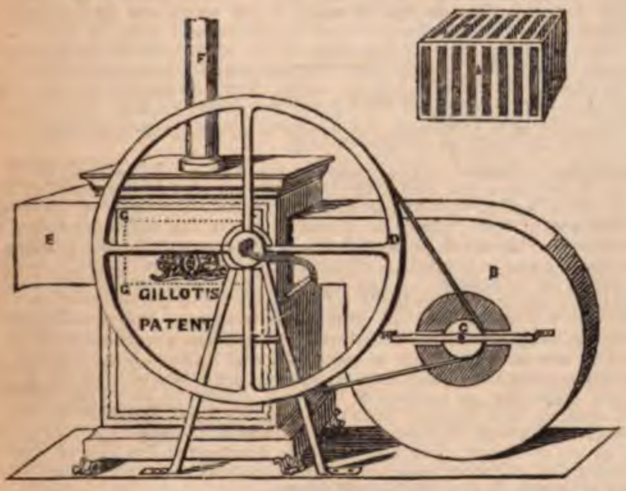


Fig. 1.

Fig. 2.

A. The Stove. The door of the fire-place opens on the opposite side. B. the Box containing the Fan. C. The Pulley on the spindle to which the fan is attached, over which passes a strap leading to D. the Fly Wheel, the turning of which sets the fan in motion, and drives the air through the cockle, Fig. 2, placed at G G, Fig. 1. and the air is carried through E, the delivering pipe to any part required. F. The chimney either ascending or descending.

This apparatus for heating and ventilating, may be seen in use at No. 1, Liverpool-street, Finsbury. The fire-place is similar in construction to ordinary hot air stoves, over which is placed a cockle, see Fig. 2, through the vertical spaces, A A, in which the fire passes, and the air, by the revolving of the fans, is driven through the intermediate spaces, B B, into the delivering pipe, E, Fig. 1. The purity and quantity of the heat produced by this apparatus, must be witnessed to be believed; the air is driven with such velocity through the cockle, that the oxygen is not destroyed, as is the case, more or less, in all self-acting hot air stoves. The quantity of heat to be obtained is limited only by the size of the apparatus used, and the number of revolutions of the fan; any building, however large, can easily and speedily be warmed; in fact, this apparatus is capable of effecting all that can be desired for warming churches, all large public buildings, drying corn, new buildings, and manufactories of all kinds, where heat, with perfect safety and economy is required. It is not necessary that the apparatus should be upon the premises, but the heat may be conveyed into any factory or building, by trunks or pipes.

PATENT STUCCO PAINT CEMENT.

In a former number we slightly alluded to this new cement, deferring until we had an opportunity of examining into its qualities, to recommend it to the notice of the profession, which we are now enabled to do, after having carefully investigated its properties, and examined several samples of the cement, at Messrs. Mann's, Maiden-lane, in the City. It appears to be a cement possessing superior qualities, and to be well adapted for external works, particularly in exposed and damp situations, such as on the sea coast, and south-western aspects. At Plymouth, where the cement is manufactured by Messrs. Johns, the patentees, and where the principal ingredient is obtained, it has been tried for the last three years, and subjected to the most rigid tests with perfect success. Its strong adhesive properties cause it to adhere to almost any substance; specimens may be seen on glass, wood, slate, tile, and brick. The nature of the materials of which the cement is composed, renders it highly repellant of water, and impervious to wet or damp. It is sold in a semi-liquid state, which has the appearance of white lead; and when used it is mixed with three times its weight of sharp sand, to the consistency of mortar, and laid on the wall with a trowel in the same manner as cement, and with about the same labour. It is finished off at once, with either a fine or a coarse coat, as may be desired; it dries gradually, and in two or three days time the surface becomes as hard as stone, to which it has all the appearance, without colouring. It may likewise be used for interiors, and painted over within a few days, a couple of coats being sufficient to cover it, as the cement is not of that absorbent character as stucco or roman cement.

The cost of the fluid cement is 14s. per cwt., and for covering a yard superficial of brick-work, it requires 7 lbs. of cement, and 21 lbs. of sand, or 4 lbs. of cement, and 12 lbs. of sand, if laid on a coat of plastering, or 1 cwt. of cement will take one bushel of sand, and cover 14 yards. The prime cost, including labour, is about 1s. 6d. per square yard, which is a low price, considering the excellent qualities of the material, and that it does not require colouring. We strongly recommend the architect to give the cement a fair trial. Some specimens may be seen at the office of the Journal.

THE ARTESIAN WELL AT GRENELLE, PARIS.

We have at various times given an account of this well, the first description of the labours of M. Mulot, up to the time of his accomplishing the objects in obtaining water, appeared in the *Journal* for April 1841, p. 131, vol. 4; and in the *Journal* for the following July, we gave a farther account, explaining the size of the tubes, and the geological character of the strata through which the boring passed. All the reports that have recently appeared in different publications nearly correspond with our reports, and the engraving lately published in Paris, showing the strata does not differ much form our description, but it gives the strata more minutely, which we now give in a tabular form. It will be perceived that the formation is identical with that of the London Basin below the London Clay.

Depth in ft.	STRATA.	Formation.
	Gravel and Sand	
13.		
	Cockle Shells	Plastic Clay.
	Quartoze Sand with fine particles of sulphuret of iron	
	Fine Sand	
	Argillaceous Sand	
	Mottled Clay	
	Sand and Clay with nodules of Limestone	
180.		
	White Chalk with layers of flints	White Chalk.
328.		
	White Chalk alternating with stata of dolomite and small pieces of silex	
886.		
	Gray chalk with small particles of silex	Gray Chalk.
1049.		
	Gray Chalk, compact without silex	
1453.		
	Green Chalk and green particles of the silicate of iron	Chalk Marl.
	Blue argillaceous Chalk	
	Blue argillaceous and sandy chalk, with particles of mica, and veins of green chalk	
1634.		
	Clay with iron pyrites, nodules of the phosphate of lime and fossil debris	Gault.
	Geeen Sand	
	Clay and Greenish Sand with grains of quartz	
	Argillaceous Sand	
	Green and White Sand	
1794.		
	Water	

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM NOVEMBER 2ND TO NOVEMBER 17TH, 1842.

Six Months allowed for Enrolment, unless otherwise expressed.

MATTHEW GREGSON, of Toxteth Park, Liverpool, esquire, for "*improvements applicablo to the sawing or cutting of veneers.* (A communication.)—Sealed November 2.

JOSEPH EDWARDS, of Bloomsbury-square, clerk, for "*an improved razor-strop, or instrument for sharpening certain cutting edges, and an improved material for covering the same, which material is also applicable to other purposes.*"—Nov. 2.

SIR J. SCOTT LILLIE, of Chelsea, for "*improvements in roads.*"—Nov. 2.

PIERRE PELLITAN, of Bedford-square, esquire, for "*improvements in the production of light.*"—Nov. 2.

JAMES BULLOUGH, of Blackburn, overlooker, for "*improvements in the construction of looms for weaving.*" (A communication.)—Nov. 3.

RICHARD BEVAN, of Liverpool, wine-merchant, for "*arrangements connected with the circulation of steam employed in pipes or tubes for producing heat, and the application of such arrangements to various purposes.*"—Nov. 5.

JOHN ROTHWELL, of Great Bolton, grocer, for "*a composition and preparation to promote the ignition and combustion of coke, coal, and other combustible substances, in stoves, furnaces, and grates.*"—Nov. 5.

WILLIAM COLEY JONES, of Vauxhall-walk, Lambeth, practical chemist, for "*improvements in treating or operating upon a certain unctious substance, in order to obtain products therefrom for the manufacture of candles, and other purposes.*"—Nov. 8.

PIERRE FREDERICK INGOLD, of Buckingham-place, Hanover-square, watch-maker, for "*improvements in machinery for making parts of watches and other time-keepers.*—Nov. 8.

ARTHUR HARVIE, of Wilmington-square, gentleman, for "*improvements in the process of vinous fermentation.*" (A communication.)—Nov. 8.

THOMAS WRIGLEY, of Bridge Hall, Bury, Lancaster, paper manufacturer, for "*improvements in machinery for manufacturing paper.*"—Nov. 8.

JOHN MITCHELL, of Birmingham, steel pen manufacturer, for "*an improvement in the manufacture of metallic pens, and an improvement in the manufacture of pen-holders.*—Nov. 8.

JOHN SPINKS, the younger, of John-street, Bedford-row, gentleman, for "*an improved apparatus for giving elasticity to certain parts of railway and other carriages requiring the same.*"—Nov. 8.

HENRIK ZANDER, of North-street, Sloane-street, engineer, for "*improvements in steam-engine boilers and furnaces, and in the methods of feeding and working the same; as also in the machinery for applying steam power to propelling purposes.*"—Nov. 8.

JOHN BARNES, of Church, Lancashire, manufacturing chemist, and John Mercer, of Oakenshaw, Lancashire, calico printer, for "*improvements in the manufacture of articles used in printing and dyeing cotton, silk, woollen, and other fabrics.*"—Nov. 10.

CHARLES ROWLEY and JAMES TURNER, of Birmingham, button-makers, for "*improvements in the manufacture of perforated metal buttons.*"—Nov. 15.

ANDRE EUSTACHE GRATIEN AUGUSTE MAURRAS, of Cornhill, gentleman, for "*improvements in the process and apparatus for filtering water and other liquids.*" (Partly a communication.)—Nov. 15.

CHARLES SMITH, of Newcastle-street, Strand, for "*improvements in the manufacture and application of bricks, tiles, and other plastic articles or surfaces, and for cements or compositions to be used with, in, and about the same, for building and other useful purposes.*"—Nov. 17.

MISCELLANEA.

The Cormorant Steam Frigate.—On the 23rd ultimo Her Majesty's second class steam frigate *Cormorant*, having been fitted with a pair of engines of 300 H.P., by Messrs. Fairbairn and Co., was tried down the river from Woolwich, under the charge of one of the Admiralty pilots. This was the first trip made by the *Cormorant*, and the government engineers on board were so fully satisfied with the working of the engines and the results obtained from them, that they at once ordered her to proceed to Sheerness, where she will be got ready immediately to be put in commission. The diameter of the cylinders is 65½ in., and the length of the stroke 5 ft. 3 in. The average number of strokes during the trial was 21½, the boilers generating an ample supply of steam. The draught of water of the vessel was 12 ft. 2 in. aft, and 10 ft. 3½ in. forward, the guns and armament not being yet on board. The speed through still water, according to the trials made at the measured distance, was 11 miles an hour; but greater speed will be attained when the paddle wheels have more hold of the water. The same makers are now constructing a pair of engines of 470 H.P. for Her Majesty's first class frigate *Vulture*, building at Pembroke. In the *Journal* for next month we hope to be able to give the drawings of these engines.

Aberystwyth Harbour.—The works of the pier are left closed for this season (excepting a few jobs). There is now completed of the new pier, 261 lineal yards, leaving only 39 yards for completion. The body of the work is composed of stone, from 1 to 14 tons, in rough blocks, and filled in with rubble stone. The sea slope is pitched, and grouted, with the best Aberthaw lime mortar; and a quantity of large blocks of stone are placed at foot of sea slopes, for its protection. The inner walling is composed of very heavy stones, set and grouted with the same mortar. The parapet wall is 8 ft. above the top of the pier, and of immense thickness. The stones forming its coping, weigh from 4 to 11 tons each, and are also grouted and set with the same mortar. The height of pier is about 32 ft., from foundation to top of coping, being 12 ft. above ordinary spring tides: the width on top 40 ft., the sea slope has an inclination of 3 to 1. There is also fixed a powerful capstan and mooring posts; landing steps are built in the inner walling. A convenient storm room is also erected in the parapet, for ropes, &c., for use of vessels. The pier as far as is completed, has been the means of saving life, and an immense quantity of property; as well as the facilitating of vessels, in their ingress and egress.

THE VARIATION OF THE COMPASS.

Observations made at the Royal Observatory, Greenwich,

G. B. AIRY, Astronomer Royal.

Mean Magnetic Declination for the month of August, 1842—23° 15′ 10″

The observations of the Magnetic Dip are suspended, when they are resumed the results will be recorded as usual.

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